

Trouble-shooting instructions : OPE-5003

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : KFZ-00..

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SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* OPEL Ascona and Kadett
with 2.0 l / 4-cylinder engine
Engine type OHC, C 20 NE, 20 NE, 20 SEH
(10.86 ->)

* Motronic ML 4.1 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

Note:

Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Joint sensor for engine speed and reference mark

* Single-winding rotary actuator

* Lambda closed-loop control

* Variant encoding for octane-number adjustment and transmission

Variant coding

Octane rating	Resistance at term. 15		
	2 l engine, low compression (9.2) without cat. converter	with cat. converter with cl.-loop control	2 l engine, high compression (10), without catal. converter
91 RON	0 Ω 1)	0 Ω 1)	—
	infinity Ω 2)	infinity Ω 2)	—
	—	750 Ω 2)3)5)	—
95 RON	220 Ω 1)	220 Ω 1)	220 Ω 1)
	1200 Ω 3)4)	1200 Ω 3)	1200 Ω 3)4)
	2200 Ω 2)	2200 Ω 2)	2200 Ω 2)
	4700 Ω 2)3)4)	4700 Ω 2)3)	4700 Ω 2)3)4)
	750 Ω 2)3)4)5)	—	infinity Ω 2)3)4)5)
98 RON	470 Ω 1)	—	470 Ω 1)
			750 Ω 2)

91 RON = Regular gasoline, unleaded or leaded, for vehicles without catalytic converter

95 RON = Premium gasoline, unleaded

98 RON = Premium gasoline, leaded

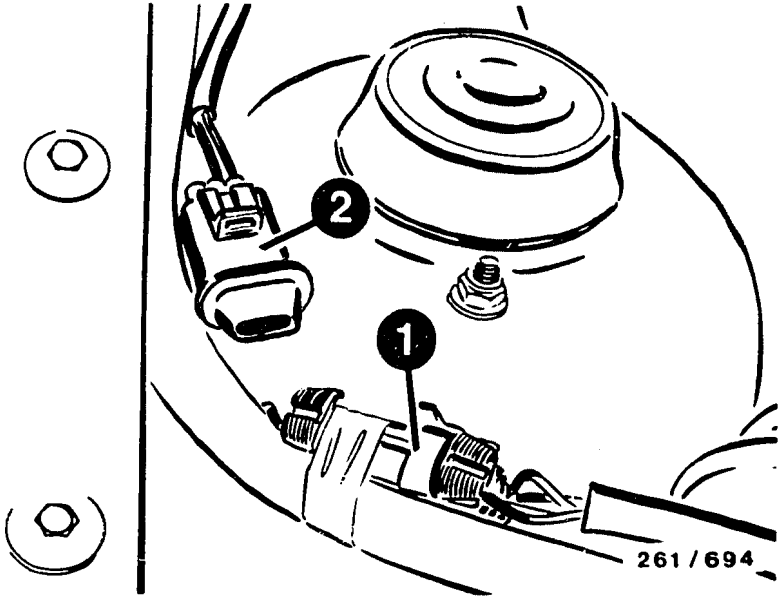
1) Basic value

2) Idle speed is increased by 100 min - .

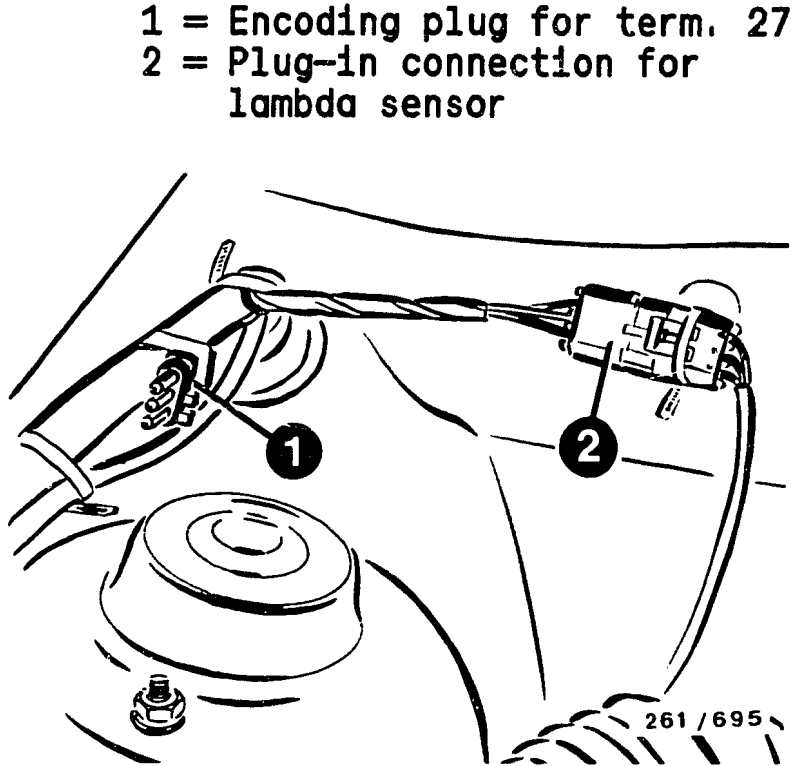
3) Acceleration enrichment is enriched.

4) Mixture is enriched: lambda +5% corresponds to approx. 1% CO.

5) Ignition timing amounts to -5.25 ° crankshaft (retarded) throughout the whole characteristic-map range.



1 = Diagnostic plug
2 = Octane-rating encoding plug (term. 15)



1 = Encoding plug for term. 27
2 = Plug-in connection for lambda sensor

Vehicles with catalytic converter:

term. 27 infinity Ω (open)

Vehicles without catalytic converter:

term. 27 zero Ω (to ground)

Vehicles with manually shifted transmission:

term. 10 infinity Ω (open)

term. 28 zero Ω (to ground)

Vehicles with automatic transmission:

term. 10 zero Ω (to ground)

term. 28 to selection-lever positions P and N. zero Ω (via selection lever to ground). In

this way, idle speed is dropped in order to prevent driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression! Motronic relay is therefore to be disconnected.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

											Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage at control unit
*											Sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*								Idle contact
					*						Full-load contact
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-induction system
		*									Idle speed
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
		*									Exhaust gas
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
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									Cause (component fault)
			*					*	Throttle valve
			*						Fuel delivery
*	*	*							Air bleed of tank
		*	*						Lambda closed-loop control
*	*	*	*	*	*	*		* * *	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Data exchange not possible			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply to control unit including term. 18 O.K. Leads and power supply O.K., however no fault output: control unit defective.	4, 12, 17, 18	_____
Lambda sensor Open circuit	13	1 3	Open circuit in lead to lambda sensor. Sensor defective.	24	_____
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short to ground.	13	_____
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Check temperature sensor and leads for open circuit (op. circ.) and short to positive (short to B+) Temperature-sensor resistance : at +15...+30°C ; at approx. +80°C :	13, ground	1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Check lead for short to ground. Watch out for worn insulation! Severe leaning, e.g. tank emptied. Leak in exhaust between engine and lambda sensor.	24	_____
Lambda sensor Short to B+	45	4 5	Check lead for short to positive (short to B+) Watch out for worn cable insulation! Mixture too rich.	24	_____
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Check voltage dips at positive and ground terminal. Charge battery. Check alternator system.	35(+), 5(-)	greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Check alternator regulator.	35(+), 5(-)	less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer Signal too low	1) 55	1) 6 5	Measure resistance of CO potentiometer (idle potentiometer) : Check lead for short to ground. Term. 3 open circuit. Term. 3 and term. 4 jumpered.	30	Measure resistance at air-flow sensor between term. 1 and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300...550 Ω)
CO potentiometer Signal too high	1) 66	1) 6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open circuit and short to positive. Fault code 7 4 is also indicated in the event of term. 4 open circuit.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch or sensor) permanently closed or lead short to ground. Idle contact closed in off position : Actuate throttle valve somewhat : In the event of increased idling speed or "hunting" idle actuator or control unit defective.	2, ground	approx. 0 Ω infinity Ω
Air-temp. sensor Short to ground	69	6 9	Check temperature sensor and lead for short to ground.	22	—
Air-temp. sensor Open circuit	71	7 1	Check temperature sensor and leads for open circuit. Temperature-sensor resistance : at +15°C...+30°C:	22, 6(-)	1450...3300 Ω

1) Potentiometer has no effect on CO in vehicles with cat.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch or sensor) permanently closed. Fault lamp only lights up sporadically during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	approx. 0 Ω infinity Ω
Air-flow sensor/ Air-mass sensor, Signal too low	73	7 3	Check: Lead to air-flow sensor term. 2 for short to ground, leads to term. 2 and term. 3 for open circuit, leads to term. 3 and term. 4 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	—
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Check: Lead to air-flow sensor term. 4 for open circuit (note: fault code 66 also appears), leads to term. 2 and term. 4 for short to positive (5V or B+). Check resistances of air-flow sensor : between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Check lead for short to ground. Transmission control unit (if fitted) faulty. Continue testing with electronic transmission control.	8	—
No fault stored		1 2	Flashing code 1-2 is constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	—

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,3...2,7 bar
Electric fuel pump	
* Delivery	
(measured in return line)	min. 850 cm ³ /30s
Supply voltage	
(under load):	min. 12 V
Temperature sensor (intake air)	
* Internal resistance	
measured at air-flow sensor	
between term. 4 and term. 5	
at ambient temperature	
(+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine),	
plug color, blue.	
* Internal resistance	
at ambient temperature	
(+ 15° C...+ 30° C):	1450...3300 Ω
engine at operating temperature	
(approx. + 80° C):	280...360 Ω
Solenoid-operated injection valve	
* Internal resistance	
at ambient temperature	
(+ 15° C...+ 30° C):	14,5...17 Ω
Air-flow sensor	
* Internal resistance between:	
term. 2 and term. 4 :	8...2500 Ω (1)
term. 3 and term. 4 :	300... 550 Ω
term. 1 and term. 4 (CO potentiometer):	
Minimum	0... 30 Ω
Maximum: the actual value measured between	
term. 3 and term.4 may be up to	
30 Ω less.	
(1) Slowly deflect air-flow sensor flap as far	
as it will go.	
Fluctuating increase in resistance; slight	
decrease towards end.	

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor	
* Internal electrical resistance	
at ambient temperature	
(+15°C...+30°C):	400...800 Ω
* Air gap:	0,8±0,5 mm
Throttle-valve switch	
* Resistance value of idle contact	
term.18 and term.2):	0 Ω
* Resistance value of full-load	
contact (term.18 and term.3)	0 Ω
Pressure sensor (altitude sensor)	
* Total resistance between	
term.3(+) and term.2(-) :	2300...2500 Ω
* Resistance between wiper	
term.1(S) and term.2(-) :	400...2300 Ω
Test specification is altitude-dependent	
Idle actuator	
* Internal electrical resistance	
at +15°...+30°C :	approx. 8 Ω
Lambda sensor	
* Resistance value of heater winding	1...15 Ω
Ignition coil	
* Primary resistance	approx. 0 Ω
* Secondary resistance	6400...11100 Ω
Interference-suppression resistors	
* High-voltage distributor rotor:	1 k Ω
The secondary side of the ignition system must be	
interference-suppressed with at least 5k Ω total	
resistance. High-voltage resistance cables are	
installed as standard.	

TEST SPECIFICATIONS (CONTINUED)

Idle test:

Engine at normal operating temp.,
switch off consuming devices.

* Idle speed: 720...780 min⁻¹ +)

* Spark advance: 10± 5 ° crankshaft +)

Automatic transmission at N or P

CO-content: without cat. converter

% CO by vol. 0,4...1 +)

Adjust mixture at CO
potentiometer in air-flow
sensor:

Turning counterclockwise results in a leaner mixture,
turning clockwise results in a richer mixture.

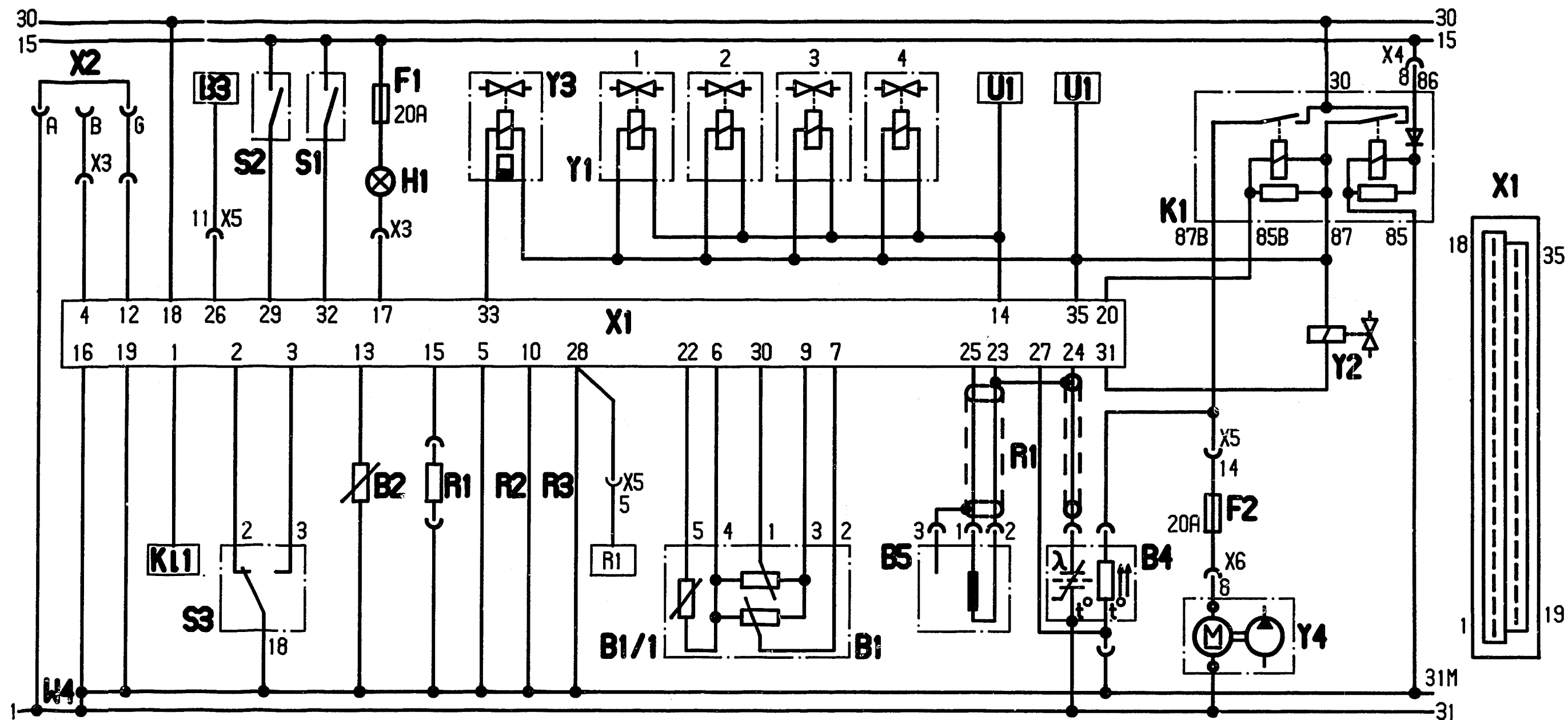
Using the potentiometer, the duration of
injection can be adjusted by max. 0,5 ms

* Catalytic-converter vehicles:: 0 % CO by vol.

For production reasons:
continued on the following
coordinate.

+) Attention! The basic value stated may deviate due to
variant coding. Observe table in "Special features"
section.

See equipment and Autodata microcards for
setting values for valve clearance and other
engine-specific data.



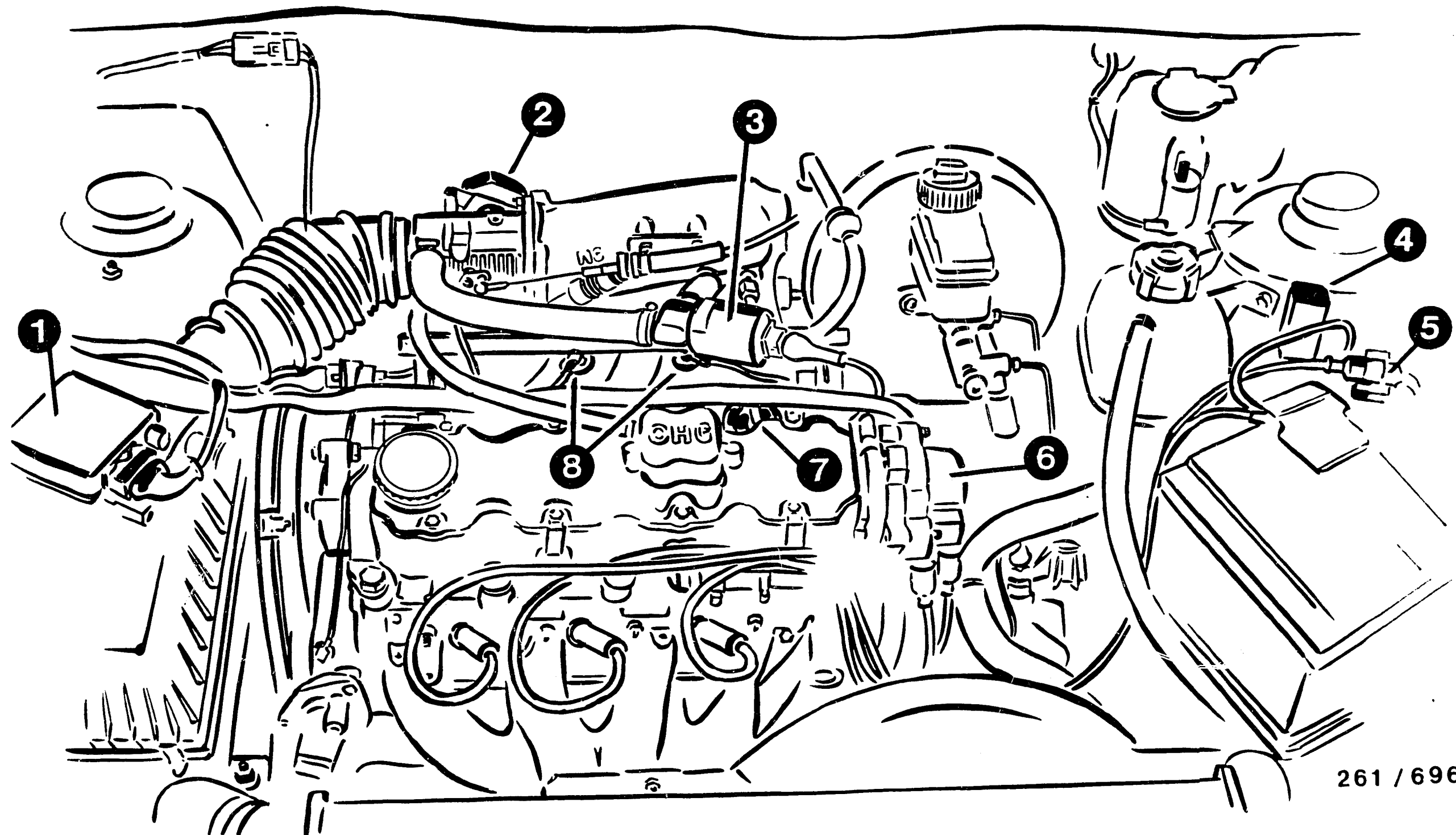
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ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
 B1/1= Temperature sensor (air)
 B2 = Temperature sensor (engine)
 B3 = Dist.-travelled freq. sensor
 B4 = Lambda sensor
 B5 = Engine-speed/ref.-mark sensor
 F1,F2 = Fuse 20 A

H1 = Fault lamp
 K1 = Motronic relay
 K1.1= Ignition coil term. 1
 R1 = see variant encoding
 R2 = Automatic transmission only
 R3 = Manual transmission only
 S1 = A/C
 S2 = Switch, compressor
 S3 = Throttle-valve switch

U1 = Vehicle computer
 W4 = Engine ground strap
 X1 = Motronic control-unit plug
 X2 = Diagnosis plug
 Y1 = Injection valves
 Y2 = Tank ventilation valve
 Y3 = Idle actuator
 Y4 = Electric fuel pump

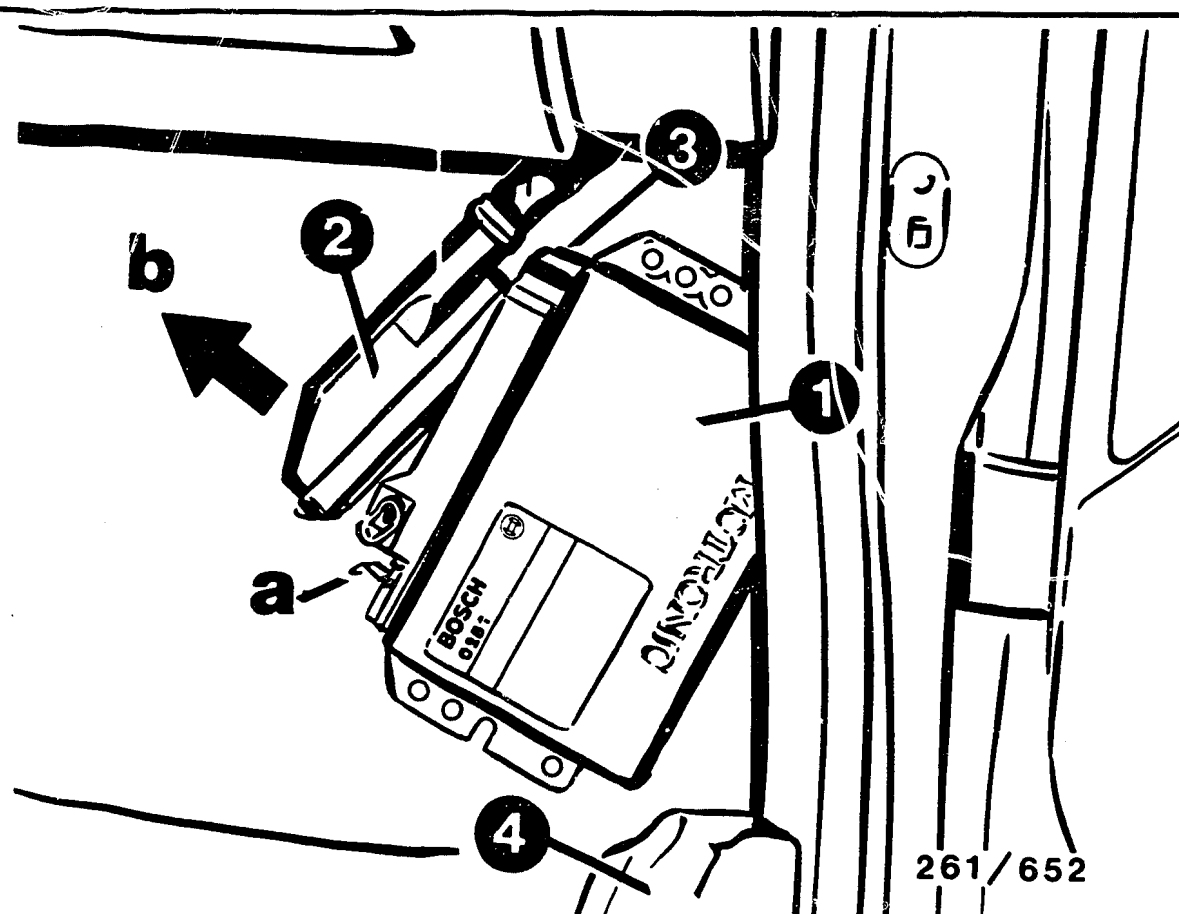


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INSTALLATION POSITION OF COMPONENTS

- 1 = Air-flow sensor
- 2 = Throttle-valve switch
- 3 = Idle actuator
- 4 = Motronic relay

- 5 = Ignition coil
- 6 = High-voltage distrib.
- 7 = Pressure regulator
- 8 = Injection valve

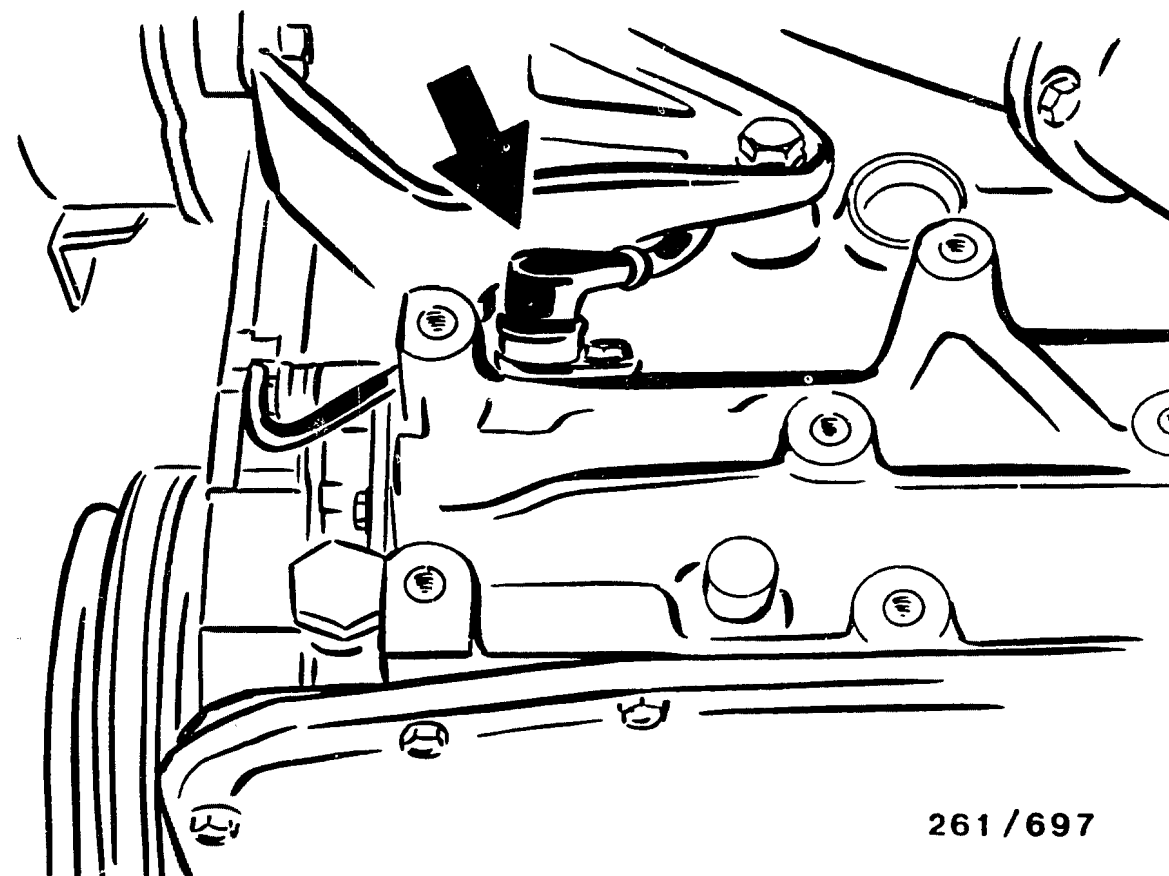


- 1 = Control unit
- 2 = Plug
- 3 = Mechanical encoding with locking lug
- 4 = Cover over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "left" and "right" refer always to the forward direction of travel.

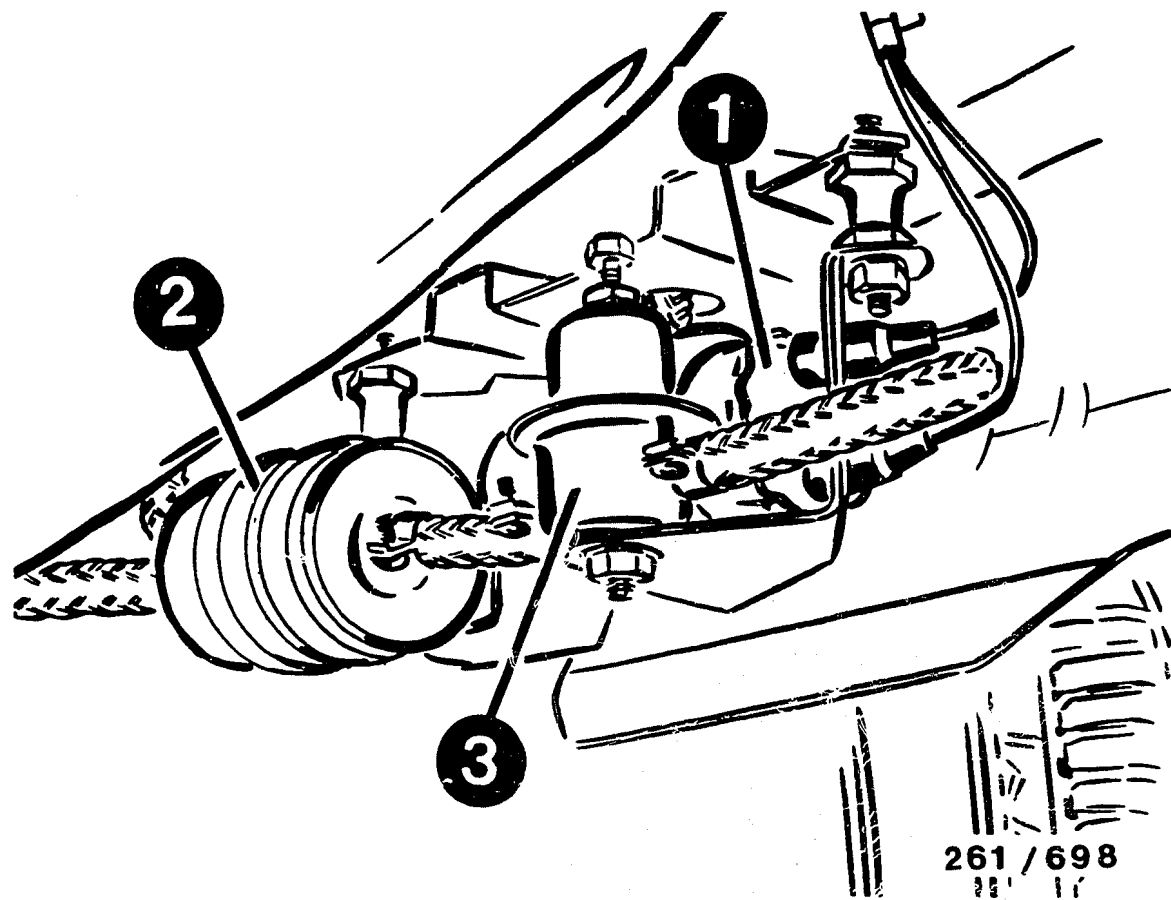
- * Control unit:
In front-passenger footwell on right-hand side. Slightly raise rubber strip and cover on door sill. Fold carpet to side and remove control-unit cover. Unscrew control unit. Unlock plug (a), hinge (arrow b) and unhook (Item 3).
- * Temperature sensor (engine):
In engine block below mounting of alternator.



Arrow = Reference-mark/engine-speed sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Reference-mark/engine-speed sensor:
In engine block, left, behind V-belt pulley beneath fastening flange.
- * Lambda sensor:
In common exhaust pipe before catalytic converter.
- * Fuses:
In instrument panel at bottom left. Fuse box can be hinged out on its lower side.
- * Temperature sensor (air):
In air-flow sensor



- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Pressure damper

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump and fuel filter:
Between the fuel tank and right-hand rear wheel.
- * Ground terminals:
On the engine block at the front on the right, beneath the engine-oil filler-neck cap.
- * Diagnostic plug:
In the engine compartment on the right at the spring-strut dome.
- * Octane-rating encoding plug:
In the engine compartment on the right at the spring-strut dome.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Tank bleeder valve:
In the engine compartment on the left next to the ignition coil.
- * Carbon filter:
In the engine compartment on the left next to the battery.

Trouble-shooting instructions : OPE-5004

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : KFZ-00..

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These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* OPEL Omega
with 2.0 l / 4-cylinder engine,
engine type OHC, C 20 NE and 20 SE
(10.86 ->)

* Motronic ML 4.1 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

Note:

Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Joint sensor for engine speed and reference mark

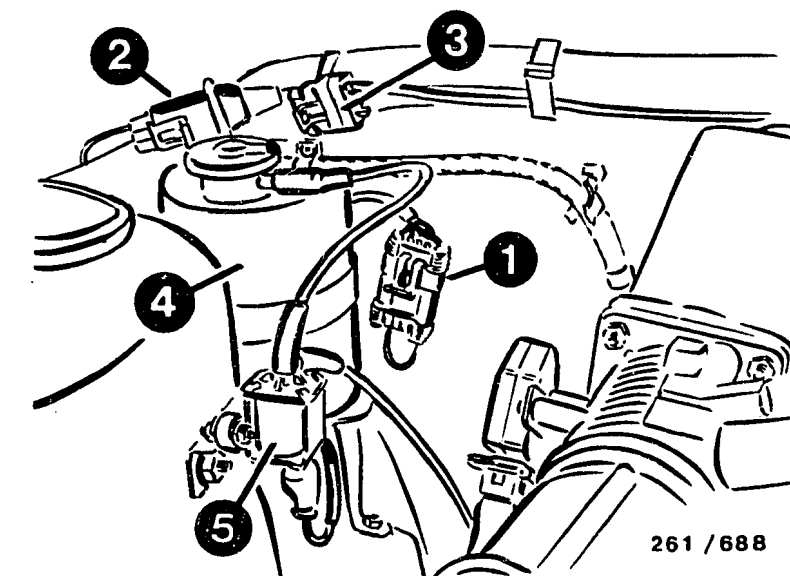
* Single-winding rotary actuator

* Lambda closed-loop control

* Variant encoding for octane-number adjustment and transmission

Variant coding

Octane rating	Resistance at term. 15		
	2 l engine, low compression (9.2) without cat. converter	with cat. converter with cl.-loop control	2 l engine, high compression (10), without catal. converter
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	750 Ω 2)3)4)5)	—	infinity Ω 2)3)4)5)
98 RON	470 Ω 1)	—	470 Ω 1)
			750 Ω 2)



- 1 = Diagnostic plug
- 2 = Octane-rating encoding plug
- 3 = Encoding plug for term .27
- 4 = Carbon filter
- 5 = Tank ventilation valve

91 RON = Regular gasoline, unleaded or leaded, for vehicles without catalytic converter

95 RON = Premium gasoline, unleaded

98 RON = Premium gasoline, leaded

1) Basic value

2) Idle speed is increased by 100 min - .

3) Acceleration enrichment is enriched.

4) Mixture is enriched: lambda +5% corresponds to approx. 1% CO.

5) Ignition timing amounts to -5.25 ° crankshaft (retarded) throughout the whole characteristic-map range.

Vehicles with catalytic converter:

term. 27 infinity Ω (open)

Vehicles without catalytic converter:

term. 27 zero Ω (to ground)

Vehicles with manually shifted transmission:

term. 10 infinity Ω (open)

term. 28 zero Ω (to ground)

Vehicles with automatic transmission:

term. 10 zero Ω (to ground)

term. 28 to selection-lever posi-

tions P and N. zero Ω (via

selection lever to ground). In

this way, idle speed is dropped in

order to prevent driving off. In

all other selection-lever posi-

tions, term. 28 is open (0 Ω)

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

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In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

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Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!
Motronic relay is therefore to be disconnected.

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6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

												Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*												Voltage at control unit
*												Sensor
*		*			*	*						Fuel pressure
*		*				*	*					Solenoid-operated injection valves
		*	*									Idle contact
					*							Full-load contact
	*	*	*	*	*	*						Air-flow sensor
	*	*	*									Idle actuator
*	*	*	*									Air-induction system
		*										Idle speed
*		*		*	*							Ignition coil
*		*	*	*	*							Primary signal
		*	*	*	*	*						Secondary pattern
*	*	*	*		*	*		*	*			Ignition point
		*										Exhaust gas
		*										Overrun cut-off
		*	*	*								Interference-suppression resistors
		*	*	*								Noise test
					*							Interference

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							Cause (component fault)
	*					*	Throttle valve
	*						Fuel delivery
*	*	*					Air bleed of tank
	*	*					Lambda closed-loop control
*	*	*	*	*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

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Lambda sensor Open circuit	13	1 3	Open circuit in lead to lambda sensor. Sensor defective.	24	_____
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short to ground.	13	_____
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Check temperature sensor and leads for open circuit (op. circ.) and short to positive (short to B+) Temperature-sensor resistance : at +15...+30°C : at approx. +80°C :	13, ground	1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Check lead for short to ground. Watch out for worn insulation! Severe leaning, e.g. tank emptied. Leak in exhaust between engine and lambda sensor.	24	_____
Lambda sensor Short to B+	45	4 5	Check lead for short to positive (short to B+) Watch out for worn cable insulation! Mixture too rich.	24	_____
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Check voltage dips at positive and ground terminal. Charge battery. Check alternator system.	35(+), 5(-)	greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Check alternator regulator.	35(+), 5(-)	less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer Signal too low	1) 55	1) 6 5	Measure resistance of CO potentiometer (idle potentiometer) ; Check lead for short to ground. Term. 3 open circuit. Term. 3 and term. 4 jumpered.	30	Measure resistance at air-flow sensor between term. 1 and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4:300...550 Ω)
CO potentiometer Signal too high	1) 66	1) 6 6	Measure resistance of CO potentiometer (idle potentiometer); Test potentiometer and leads for open circuit and short to positive. Fault code 7 4 is also indicated in the event of term. 4 open circuit.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch or sensor) permanently closed or lead short to ground. Idle contact closed in off position ; Actuate throttle valve somewhat ; In the event of increased idling speed or "hunting" idle actuator or control unit defective.	2, ground	approx.0 Ω infinity Ω
Air-temp. sensor Short to ground	69	6 9	Check temperature sensor and lead for short to ground.	22	—
Air-temp. sensor Open circuit	71	7 1	Check temperature sensor and leads for open circuit. Temperature-sensor resistance : at +15°C...+30°C:	22, 6(-)	1450...3300 Ω

1) Potentiometer has no effect on CO in vehicles with cat.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch or sensor) permanently closed. Fault lamp only lights up sporadically during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	approx. 0 Ω infinity Ω
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Check: Lead to air-flow sensor term. 2 for short to ground, leads to term. 2 and term. 3 for open circuit, leads to term. 3 and term. 4 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	—
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Check: Lead to air-flow sensor term. 4 for open circuit (note: fault code 66 also appears), leads to term. 2 and term. 4 for short to positive (5V or B+). Check resistances of air-flow sensor : between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Check lead for short to ground. Transmission control unit (if fitted) faulty. Continue testing with electronic transmission control.	8	—
No fault stored		1 2	Flashing code 1-2 is constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	—

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,3...2,7 bar
Electric fuel pump	
* Delivery	
(measured in return line)	min. 850 cm ³ /30s
Supply voltage	
(under load):	min. 12 V
Temperature sensor (intake air)	
* Internal resistance	
measured at air-flow sensor	
between term. 4 and term. 5	
at ambient temperature	
(+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine),	
plug color, blue.	
* Internal resistance	
at ambient temperature	
(+ 15° C...+ 30° C):	1450...3300 Ω
engine at operating temperature	
(approx. + 80° C):	280....360 Ω
Solenoid-operated injection valve	
* Internal resistance	
at ambient temperature	
(+ 15° C...+ 30° C):	14,5.....17 Ω
Air-flow sensor	
* Internal resistance between:	
term. 2 and term. 4 :	8...2500 Ω (1)
term. 3 and term. 4 :	300....550 Ω
term. 1 and term. 4 (CO potentiometer):	
Minimum	0...30 Ω
Maximum: the actual value measured between	
term. 3 and term.4 may be up to	
30 Ω less.	
(1) Slowly deflect air-flow sensor flap as far	
as it will go.	
Fluctuating increase in resistance; slight	
decrease towards end.	

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor	
* Internal electrical resistance	
at ambient temperature	
(+15°C...+30°C):	400...800 Ω
* Air gap:	0,8 ±0,5 mm
Throttle-valve switch	
* Resistance value of idle contact	
term.18 and term.2):	0 Ω
* Resistance value of full-load	
contact (term.18 and term.3)	0 Ω
Pressure sensor (altitude sensor)	
* Total resistance between	
term.3(+) and term.2(-) :	2300...2500 Ω
* Resistance between wiper	
term.1(S) and term.2(-) :	400...2300 Ω
Test specification is altitude-dependent	
Idle actuator	
* Internal electrical resistance	
at +15°...+30°C :	approx. 8 Ω
Lambda sensor	
* Resistance value of heater winding	1...15 Ω
Ignition coil	
* Primary resistance	approx. 0 Ω
* Secondary resistance	6400...11100 Ω
Interference-suppression resistors	
* High-voltage distributor rotor:	1 k Ω
The secondary side of the ignition system must be	
interference-suppressed with at least 5k Ω total	
resistance. High-voltage resistance cables are	
installed as standard.	

TEST SPECIFICATIONS (CONTINUED)

Idle test:

- Engine at normal operating temp.,
switch off consuming devices.
- * Idle speed: 720...780 min ⁻¹ +)
- * Spark advance: 10 ± 5 ° crankshaft +)

Automatic transmission at N or P

CO-content: without cat. converter
% CO by vol. 0,4...1 +)

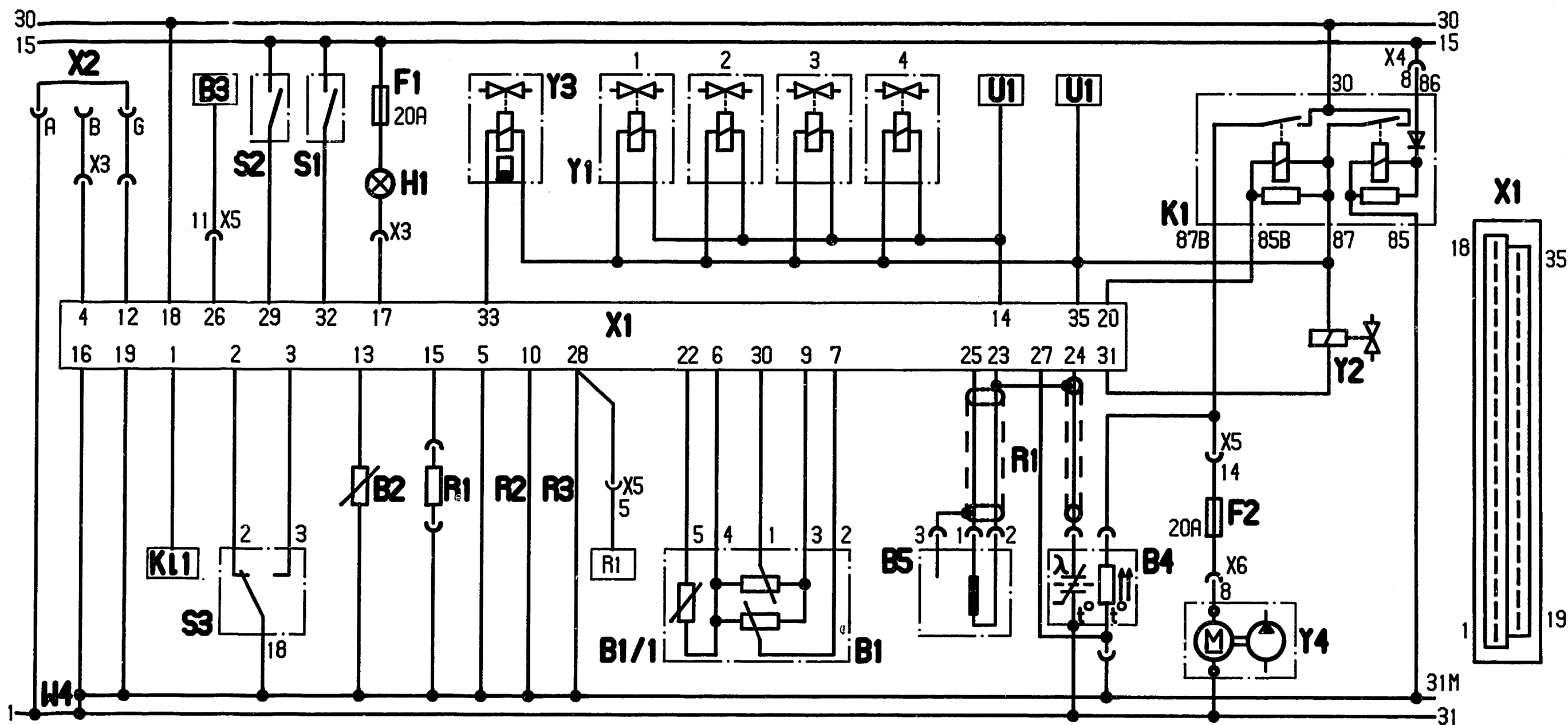
Adjust mixture at CO
potentiometer in air-flow
sensor:
Turning counterclockwise results in a leaner mixture,
turning clockwise results in a richer mixture.
Using the potentiometer, the duration of
injection can be adjusted by max. 0,5 ms

* Catalytic-converter vehicles:: 0 % CO by vol.

For production reasons:
continued on the following
coordinate.

+) Attention! The basic value stated may deviate due to
variant coding. Observe table in "Special features"
section.

See equipment and Autodata microcards for
setting values for valve clearance and other
engine-specific data.



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ELECTRICAL TERMINAL DIAGRAM

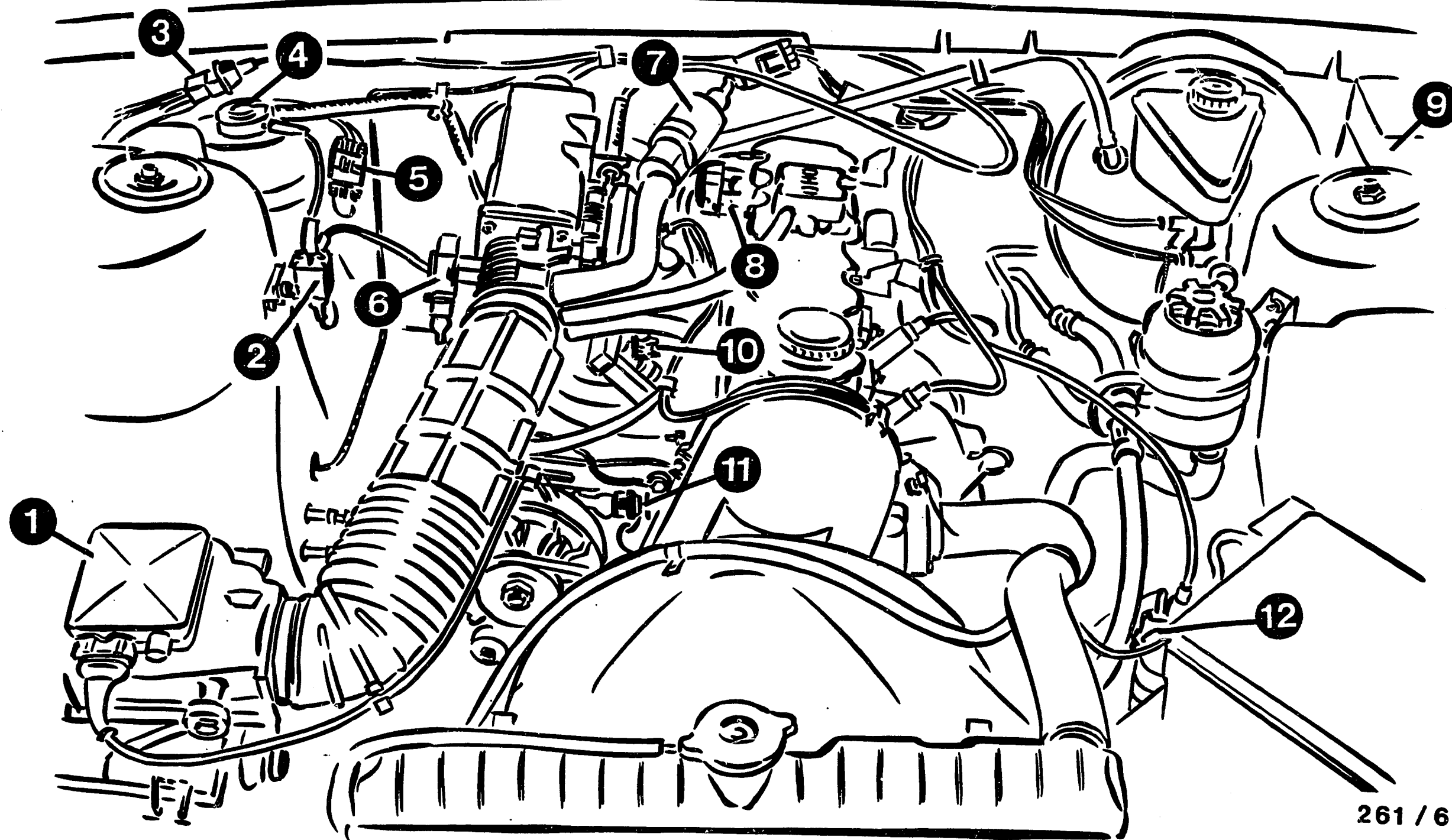
B1 = Air-flow sensor
 B1/1= Temperature sensor (air)
 B2 = Temperature sensor (engine)
 B3 = Dist.-travelled freq. sensor
 B4 = Lambda sensor
 B5 = Engine-speed/ref.-mark sensor
 F1,F2 = Fuse 20 A

H1 = Fault lamp
 K1 = Motronic relay
 K1.1= Ignition coil term. 1
 R1 = see variant encoding
 R2 = Automatic transmission only
 R3 = Manual transmission only
 S1 = A/C
 S2 = Switch, compressor
 S3 = Throttle-valve switch

U1 = Vehicle computer
 W4 = Engine ground strap
 X1 = Motronic control-unit plug
 X2 = Diagnosis plug
 Y1 = Injection valves
 Y2 = Tank ventilation valve
 Y3 = Idle actuator
 Y4 = Electric fuel pump

B19

B20

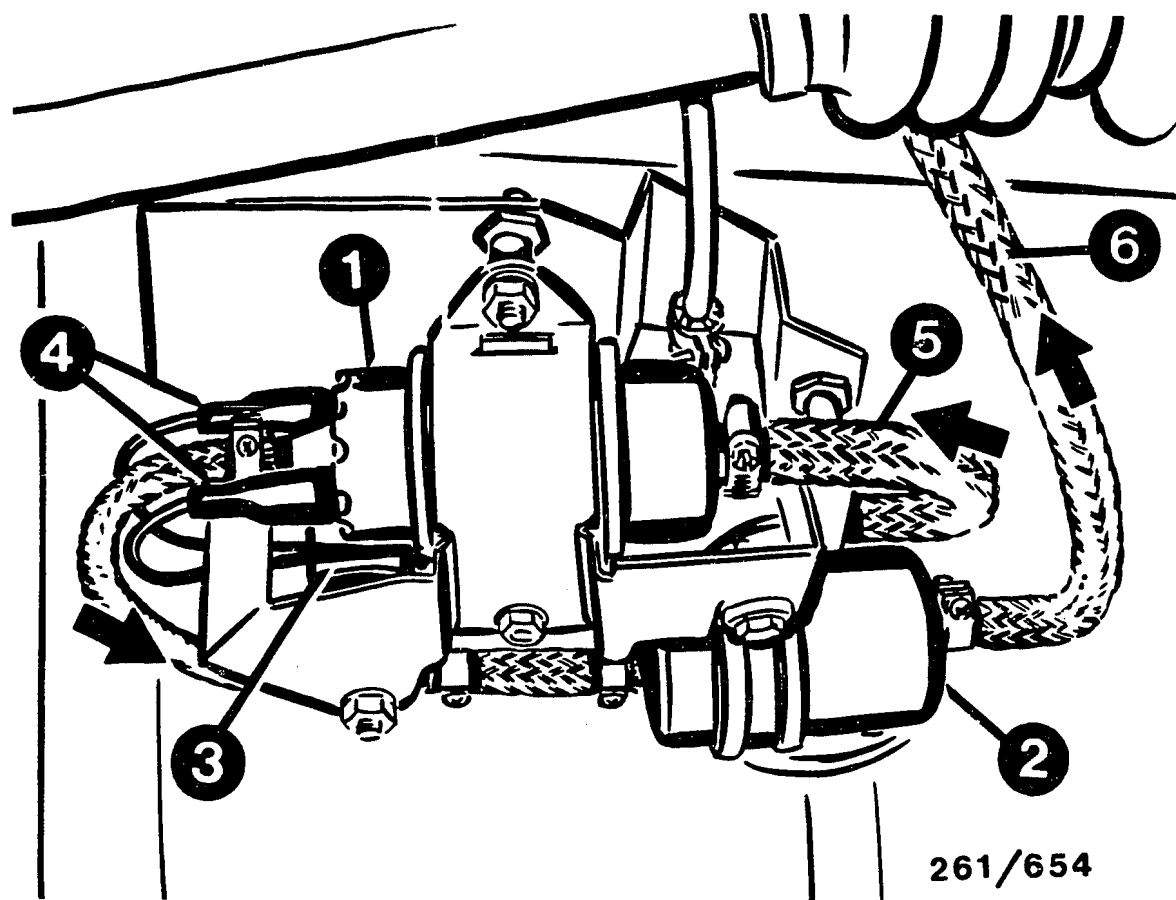


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INSTALLATION POSITION OF COMPONENTS

- 1 = Air-flow sensor
- 2 = Tank-ventilation valve
- 3 = Octane-number encoding plug
- 4 = Active-carbon filter
- 5 = Diagnostic plug
- 6 = Throttle-valve switch

- 7 = Idle actuator
- 8 = Pressure regulator
- 9 = Motronic relay
- 10 = Injection valves
- 11 = Temperature sensor (engine)
- 12 = Ignition coil

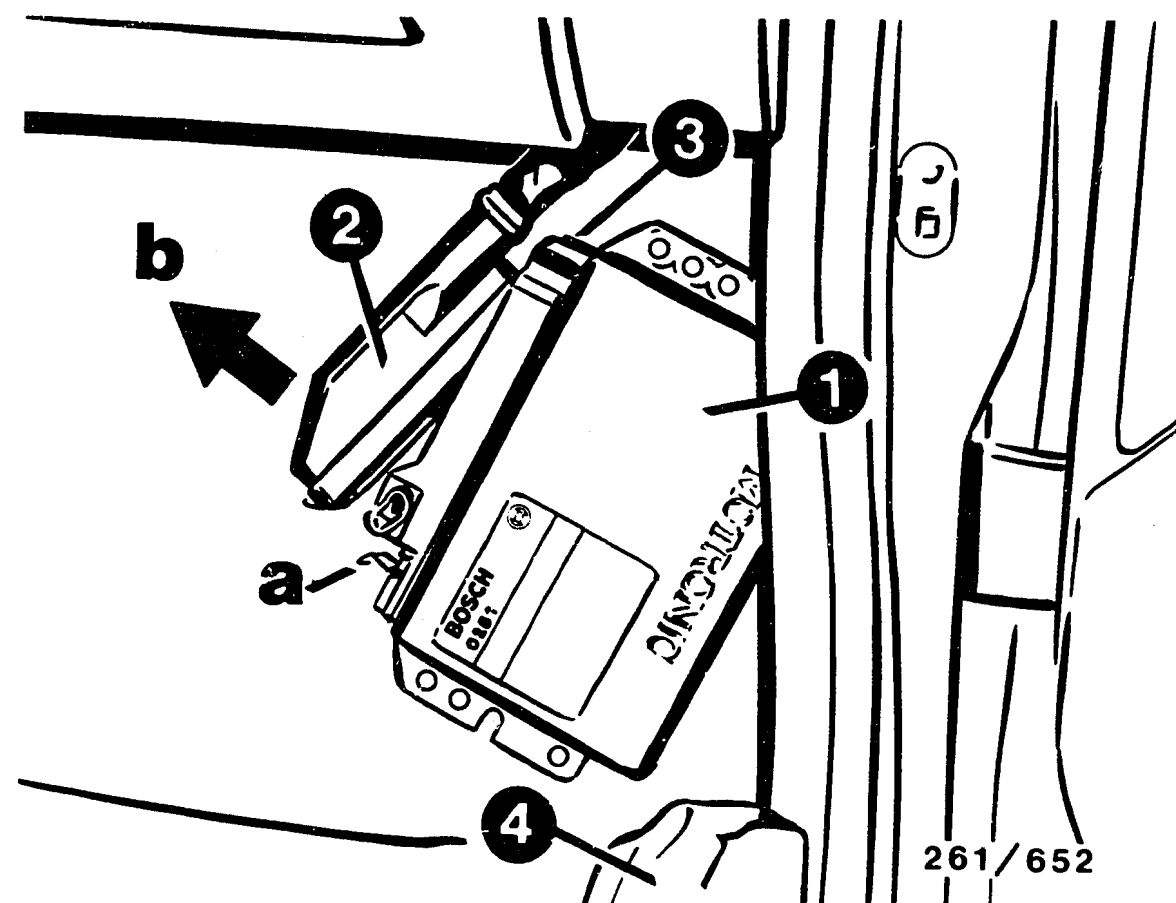


- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Pressure damper

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump and fuel filter:
In front of fuel tank.
- * Ground terminals:
On engine block at front right, under screw cover for engine oil.
- * Diagnostic plug:
In engine compartment on right on firewall.
- * Octane-number encoding plug:
In engine compartment on right on firewall.

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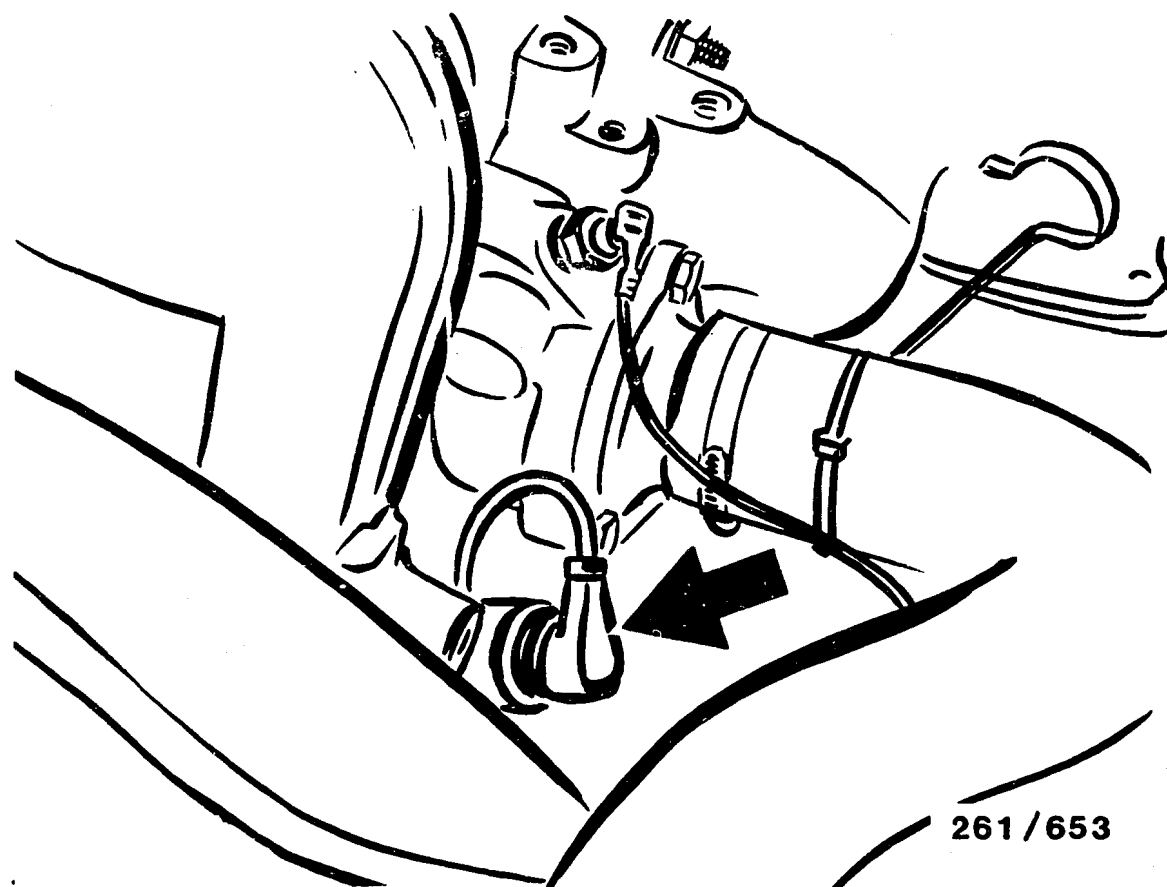
- 1 = Control unit
- 2 = Plug
- 3 = Mechanical encoding with locking lug
- 4 = Cover over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "left" and "right" refer always to the forward direction of travel.

- * Control unit:
In front-passenger footwell on right-hand side. Slightly raise rubber strip and cover on door sill. Fold carpet to side and remove control-unit cover. Unscrew control unit. Unlock plug (a), hinge (arrow b) and unhook (Item 3).
- * Temperature sensor (engine):
In engine block below mounting of alternator.

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Arrow = Reference-mark/engine-speed sensor

For production reasons:
continued on the following
coordinate.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Reference-mark/engine-speed sensor:
In engine block, left, behind V-belt
pulley beneath fastening flange.
- * Lambda sensor:
In common exhaust pipe before catalytic
converter.
- * Fuses:
In instrument panel at bottom left.
Fuse box can be hinged out on its lower
side.
- * Temperature sensor (air):
In air-flow sensor

Trouble-shooting instructions : OPE-5009
BOSCH system : Motronic ML 4.1
Make of vehicle : OPEL
Basic microcard : KFZ-00..

TABLE OF CONTENTS

Section	Coordinates
Special features	02
Structure, usage, safety and precautionary measures	06
Trouble-shooting chart	07
Self-diagnosis test table	09
Test specifications	15
Electrical terminal diagram	19
Installation position of components, notes on removal and installation	23

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

OPEL Omega 3000 (3.87 -> 1.88) and

OPEL Senator B (9.87 -> 1.88)

with 3.0 l / 6-cylinder engine,
engine type CIH, C 30 LE with
catalytic converter, 115 kW.

- * Motronic ML 4.1 with self-diagnosis
- * The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

Note:
Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).
- * As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).
- * Joint sensor for engine speed and reference mark
- * Single-winding rotary actuator
- * Lambda closed-loop control
- * Variant encoding for octane-number adjustment and transmission

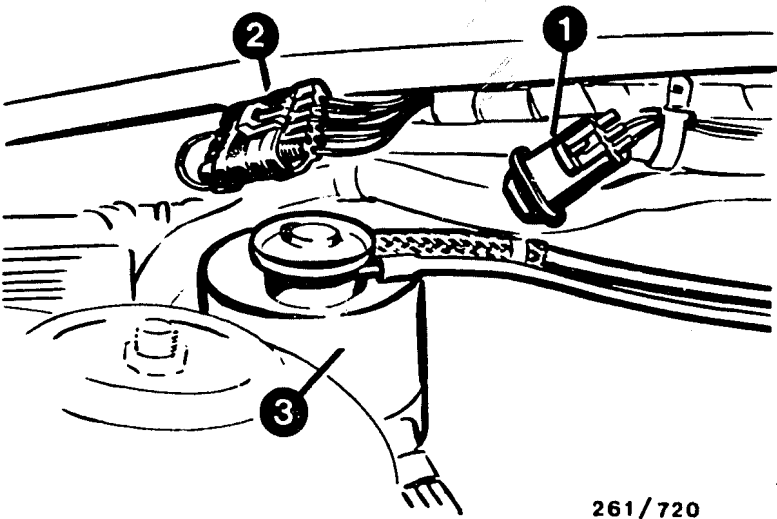
* Variant encoding

Octane-number adjustment with encoding plug. (Black plug).

Octane number	Resistance at term. 15 for 3 l engine, 115 kW with regulated catalytic converter
91 RON *)	0 Ω 1) Infinity Ω 2) 750 Ω 2)3)4)
95 RON	220 Ω 1) 1200 Ω 3) 2200 Ω 2) 4700 Ω 2)3)

*) 91 RON = Regular unleaded fuel
(only to be used in an emergency if 95 RON not available).
95 RON = Unleaded premium fuel

- 1) = Basic value
- 2) = Idle speed is increased by 100 min⁻¹.
- 3) = Idle enrichment is enriched.
- 4) = Advance is -5.25 °CS (retard direction) over entire map range.



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- 1 = Octane-rating encoding plug
- 2 = Diagnostic plug
- 3 = Activated-carbon canister

Vehicles with catalytic converter: term. 27 infinity Ω (open)

Vehicles without catalytic converter: term. 27 zero Ω (to ground)

Vehicles with manually shifted transmission:

term. 10 infinity Ω (open)

term. 28 zero Ω (to ground)

Vehicles with automatic transmission:

term. 10 zero Ω (to ground)

term. 28 to selection-lever position P and
N: zero Ω (via selection lever to ground).

In this way, idle speed is dropped in
order to prevent driving off. In all
other selection-lever positions, term. 28
is open (0 Ω)

Vehicles with air conditioner:

term. 29 to switch for defroster lever
(air-conditioner readiness for operation).

Term. 32 to switch for compressor.

Vehicles with distance-travel frequency sensor
(speedometer signal):

term. 26 connected to distance-travel
frequency sensor.

Distance-travel frequency sensor is
installed only in conjunction with
on-board computer, LCD instrument or
electronic speedometer.

* Vehicles with electronic transmission control (GS):
When shifting gear, the GS produces a brief ignition-
timing adjustment by way of the Motronic control unit.
There is thus less of a jerk when changing gear.

* Ignition distributor is used only as H.T. distributor.
Setting required.

STRUCTURE AND USAGE

These brief instructions encompass essentially
vehicle-specific special features and test
specifications (set values).

In accordance with the customer complaint,
the trouble-shooting chart leads to different
causes/component faults.
For a detailed description of trouble-shooting,
see the information in the trouble-shooting
chart of the basic instructions.

ATTENTION: Even if reference is made to
basic instructions, the set values, terminal
assignments and special features of these
vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to
avoid damage to the engine, trigger boxes and
control units or to the ignition system,
observe the information in the basic instructions.

CAUTION!

High-performance ignition system with
dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals
may prove fatal (both on the primary and
secondary sides).

Avoid fuel injection and high-tension
flashover when testing compression!
Motronic relay is therefore to be
disconnected.

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

												Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*												Voltage at control unit
*												Sensor
*		*			*	*						Fuel pressure
*		*				*	*					Solenoid-operated injection valves
		*	*									Idle contact
					*							Full-load contact
	*	*	*	*	*	*						Air-flow sensor
	*	*	*									Idle actuator
*	*	*	*									Air-induction system
		*										Idle speed
*		*		*	*							Ignition coil
*		*	*	*	*							Primary signal
		*	*	*	*	*						Secondary pattern
*	*	*	*		*	*		*	*			Ignition point
		*										Exhaust gas
		*										Overrun cut-off
		*	*	*								Interference-suppression resistors
		*	*	*								Noise test
					*							Interference

Customer complaint (symptoms of trouble)

1. Starting motor operates but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring. (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

											Cause (component fault)
				*					*		Throttle valve
				*							Fuel delivery
*	*	*									Air bleed of tank
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*		*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Data exchange not possible			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply to control unit including term. 18 O.K. Leads and power supply O.K., however no fault output: control unit defective.	4, 12, 17, 18	_____
Lambda sensor Open circuit	13	1 3	Open circuit in lead to lambda sensor. Sensor defective.	24	_____
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short to ground.	13	_____
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Check temperature sensor and leads for open circuit (op. circ.) and short to positive (short to B+) Temperature-sensor resistance : at +15...+30°C : at approx. +80°C :	13, ground	1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Check lead for short to ground. Watch out for worn insulation! Severe leaning, e.g. tank emptied. Leak in exhaust between engine and lambda sensor.	24	_____
Lambda sensor Short to B+	45	4 5	Check lead for short to positive (short to B+) Watch out for worn cable insulation! Mixture too rich.	24	_____
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Check voltage dips at positive and ground terminal. Charge battery. Check alternator system.	35(+), 5(-)	greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Check alternator regulator.	35(+), 5(-)	less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer Signal too low	1) 55	1) 6 5	Measure resistance of CO potentiometer (idle potentiometer) : Check lead for short to ground. Term. 3 open circuit. Term. 3 and term. 4 jumpered.	30	Measure resistance at air-flow sensor between term. 1 and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4:300...550 Ω)
CO potentiometer Signal too high	1) 66	1) 6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open circuit and short to positive. Fault code 7 4 is also indicated in the event of term. 4 open circuit.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch or sensor) permanently closed or lead short to ground. Idle contact closed in off position : Actuate throttle valve somewhat : In the event of increased idling speed or "hunting" idle actuator or control unit defective.	2, ground	approx.0 Ω infinity Ω
Air-temp. sensor Short to ground	69	6 9	Check temperature sensor and lead for short to ground.	22	—
Air-temp. sensor Open circuit	71	7 1	Check temperature sensor and leads for open circuit. Temperature-sensor resistance : at +15°C...+30°C:	22, 6(-)	1450...3300 Ω

1) Potentiometer has no effect on CO in vehicles with cat.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch or sensor) permanently closed. Fault lamp only lights up sporadically during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	approx. 0 Ω infinity Ω
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Check: Lead to air-flow sensor term. 2 for short to ground, leads to term. 2 and term. 3 for open circuit, leads to term. 3 and term. 4 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	—
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Check: Lead to air-flow sensor term. 4 for open circuit (note: fault code 66 also appears), leads to term. 2 and term. 4 for short to positive (5V or B+). Check resistances of air-flow sensor : between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Check lead for short to ground. Transmission control unit (if fitted) faulty. Continue testing with electronic transmission control.	8	—
No fault stored		1 2	Flashing code 1-2 is constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	—

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,8...3,2 bar
Electric fuel pump	
* Delivery (measured in return line)	min. 850 cm ³ /30s
Supply voltage (under load):	min. 12 V
Temperature sensor (intake air)	
* Internal resistance measured at air-flow sensor between term. 4 and term. 5 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine), plug color, blue.	
* Internal resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
engine at operating temperature (approx. + 80° C):	280....360 Ω
Solenoid-operated injection valve	
* Internal resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17,5 Ω
Air-flow sensor	
* Internal resistance between:	
term. 2 and term. 4 :	8...2500 Ω (1)
term. 3 and term. 4 :	300...550 Ω
term. 1 and term. 4 (CO potentiometer):	
Minimum	0....30 Ω
Maximum: the actual value measured between term. 3 and term.4 may be up to 30 Ω less.	
(1) Slowly deflect air-flow sensor flap as far as it will go. Fluctuating increase in resistance; slight decrease towards end.	

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor	
* Internal resistance at ambient temperature (+15°C...+30°C):	400...800 Ω
* Air gap:	0,8 ± 0,5 mm
Throttle-valve switch or sensor	
* Resistance value of idle contact (term.2 and term.18 or term.6 and term.4):	approx. 0 Ω
* Resistance value of full-load contact (term.3 and term.18 or term.5 and term.4):	approx. 0 Ω
Pressure sensor (altitude sensor) (if fitted)	
* Overall resistance between term.3(+) and term.2(-) :	2300...2500 Ω
* Resistance between wiper term.1(S) and term.2(-) :	400...2300 Ω
Test specification is a function of altitude	
Idle actuator	
* Internal resistance at +15°...+30°C :	approx. 8 Ω
Lambda sensor	
* Resistance value of heater winding	1...15 Ω
Ignition coil	
* Primary resistance	approx. 0 Ω
* Secondary resistance	6400...11100 Ω
Interference-suppression resistors	
* H.T. distributor rotor:	1 k Ω
The secondary side of the ignition system must feature interference suppression with at least 5 k Ω overall resistance. H.T. resistance leads are fitted as standard.	

TEST SPECIFICATIONS (CONTINUED)

Idle test:

Engine at normal
operating temperature,
switch off loads.

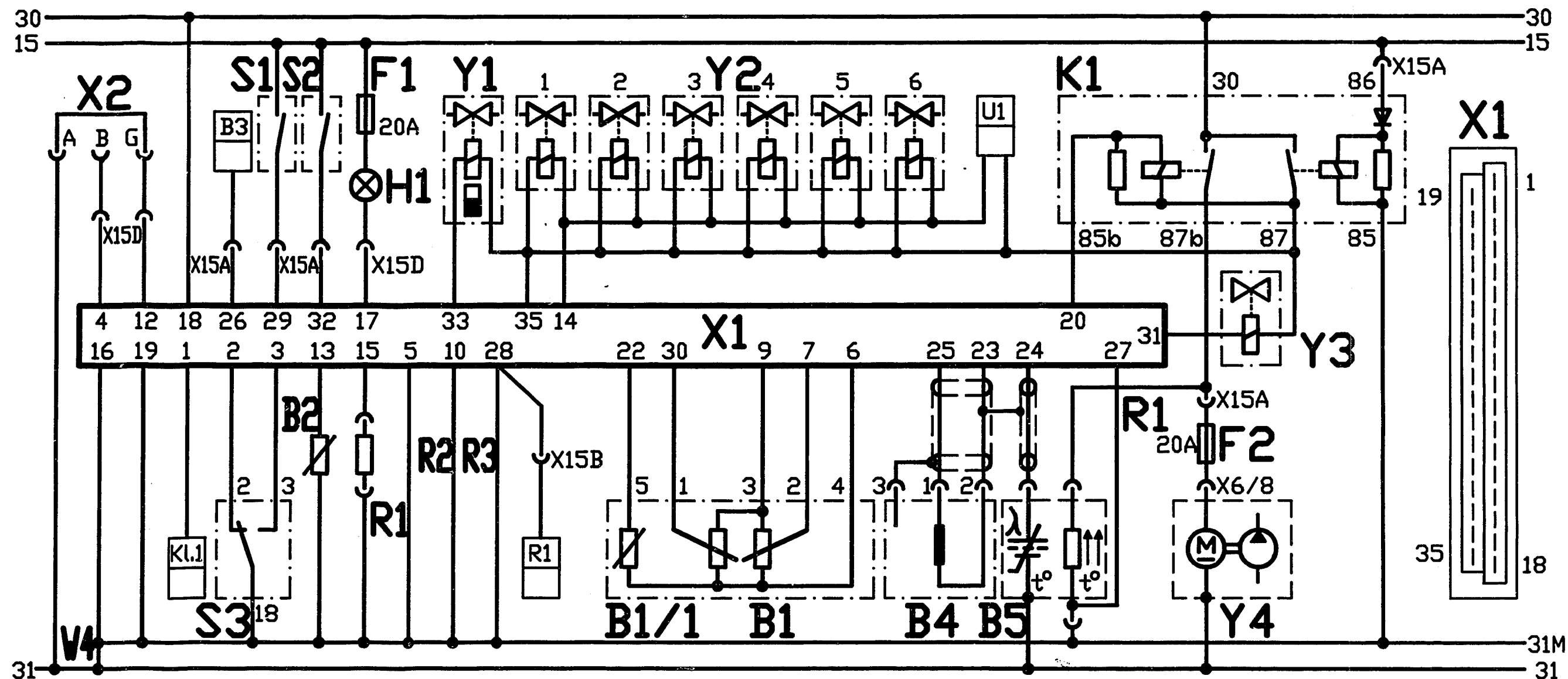
- * Idle speed: 600 \pm 40 min ⁻¹ +)
- * Spark-advance angle: 10 \pm 5 ° crankshaft +)

Automatic transmission to N or P

+) Attention! The basic values stated may deviate due
to variant encoding. Pay attention to table in
"Special Features" section.

See equipment and Autodata microcards for
settings for valve clearance and other engine-
related data.

For production reasons:
continued on the following
coordinate.

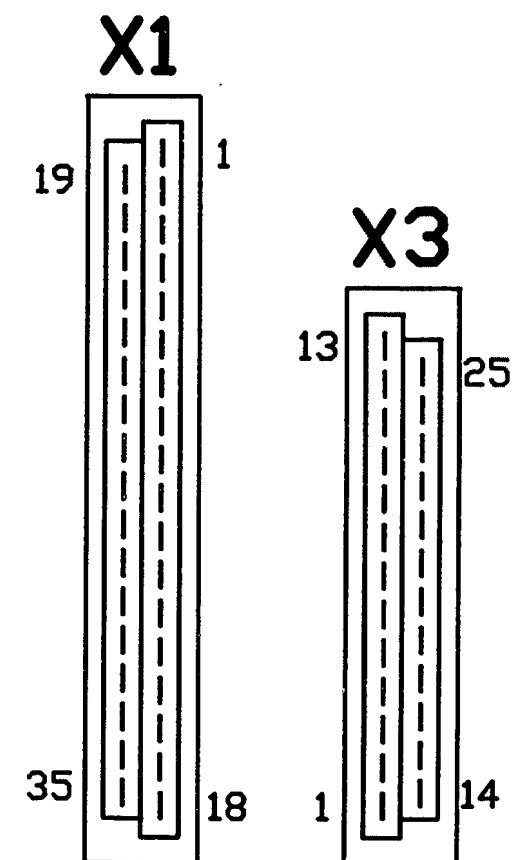
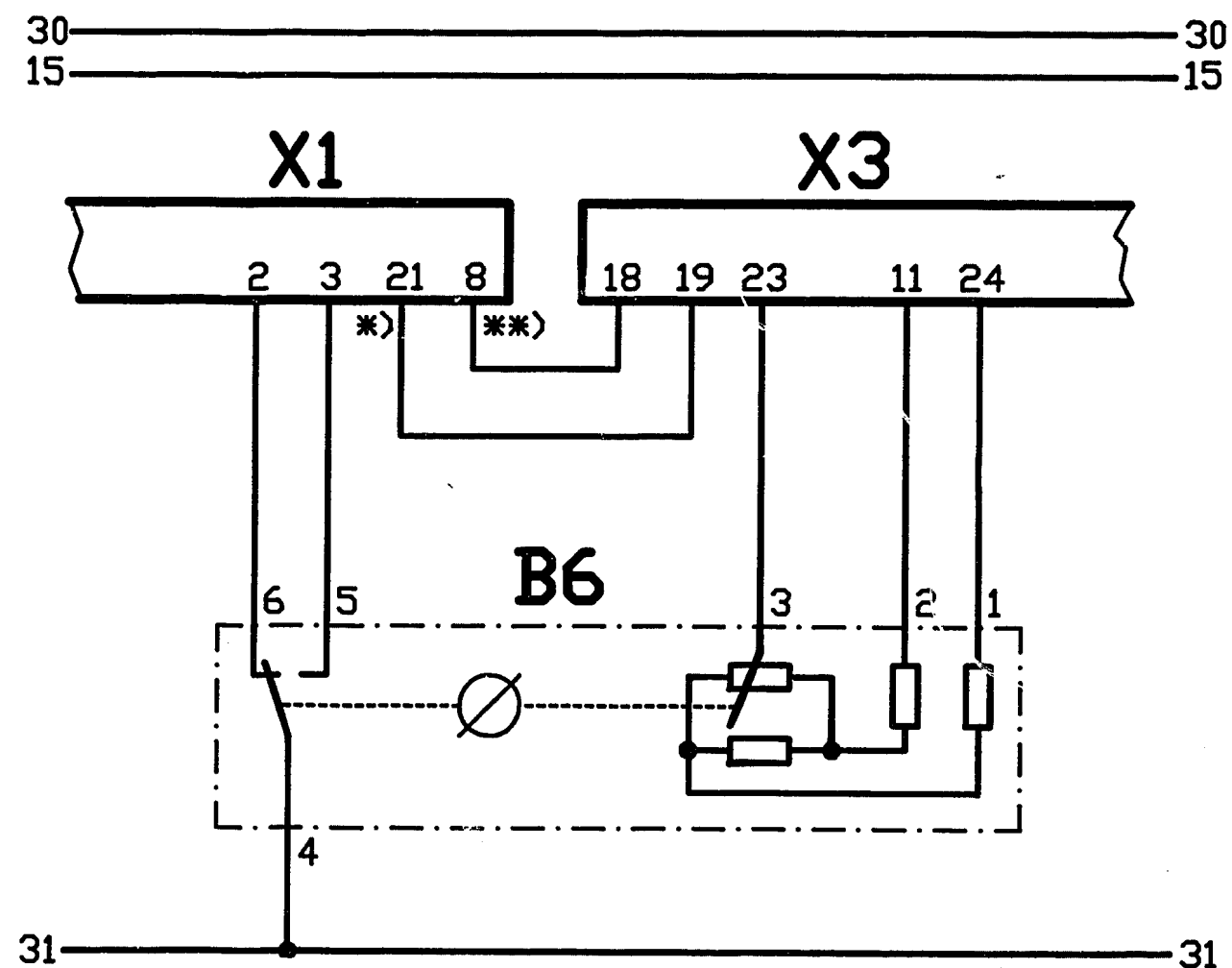


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ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
 B1/1 = Temperature sensor (air)
 B2 = Temperature sensor (engine)
 B3 = Distance travelled sensor
 B4 = Lambda sensor
 B5 = Eng.-speed/ref.-mark sensor
 F1, F2 = Fuse 20A

H1 = Fault lamp
 K1 = Motronic relay
 Term. 1 = Ignition coil term. 1
 R1 = See variant coding
 R2 = For automatic transm. only
 R3 = For man. shifted transm. only
 S1 = Switch, compressor
 S2 = Air conditioner
 S3 = Throttle-valve switch
 U1 = On board computer
 W4 = Ground strap, engine
 X1 = Motronic control-unit plug
 X2 = Diagnostic plug
 Y1 = Injection valve
 Y2 = Tank bleeder valve
 Y3 = Idle actuator
 Y4 = Electric fuel pump



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B6 = Throttle-valve switch
with potentiometer for
electronic transmission
control

X1 = Motronic control-unit plug

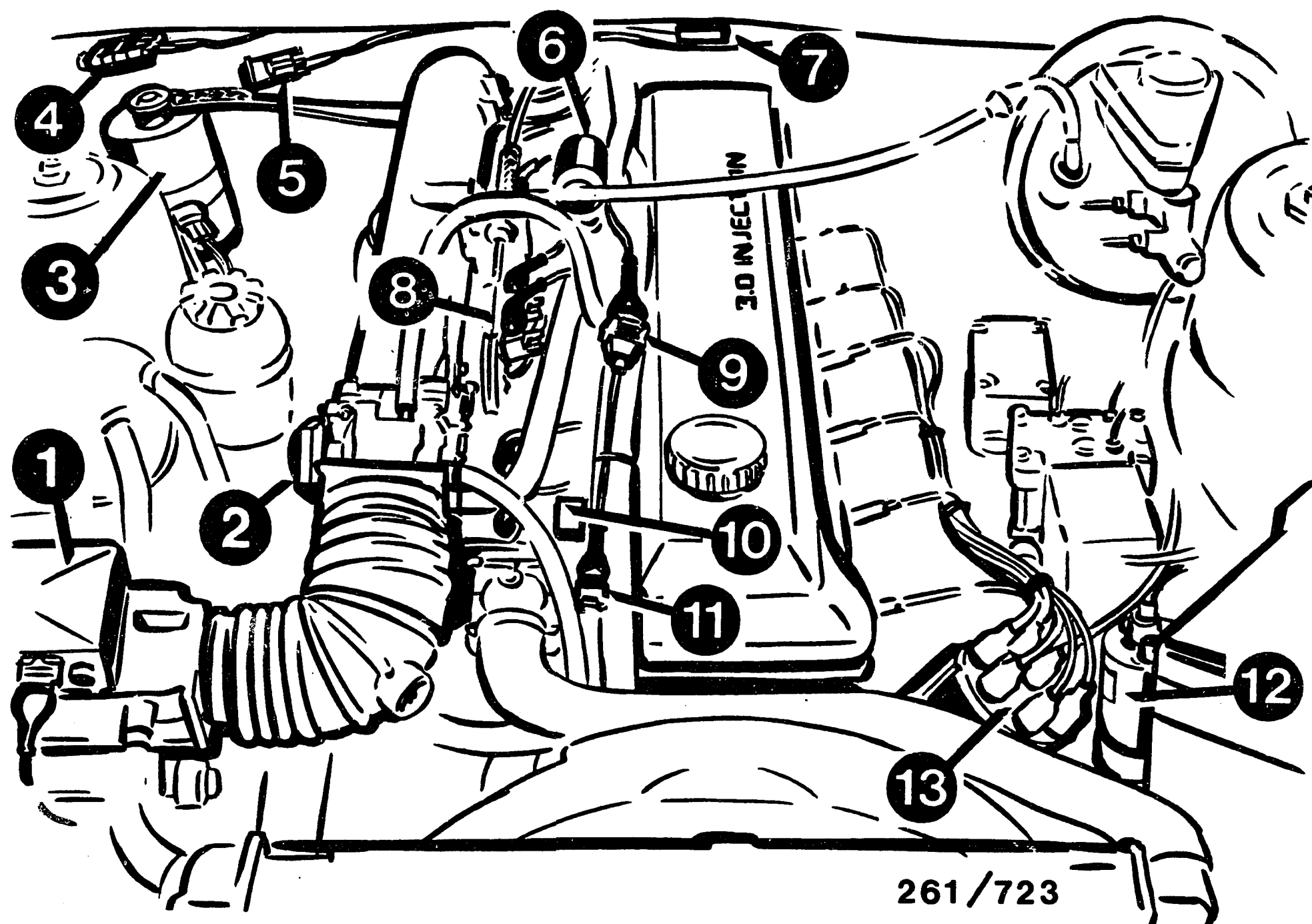
X3 = Transmission control-unit plug

*) = Output for engine speed

**) = Input for engine action

ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

Deviations for vehicles with electronic transmission control

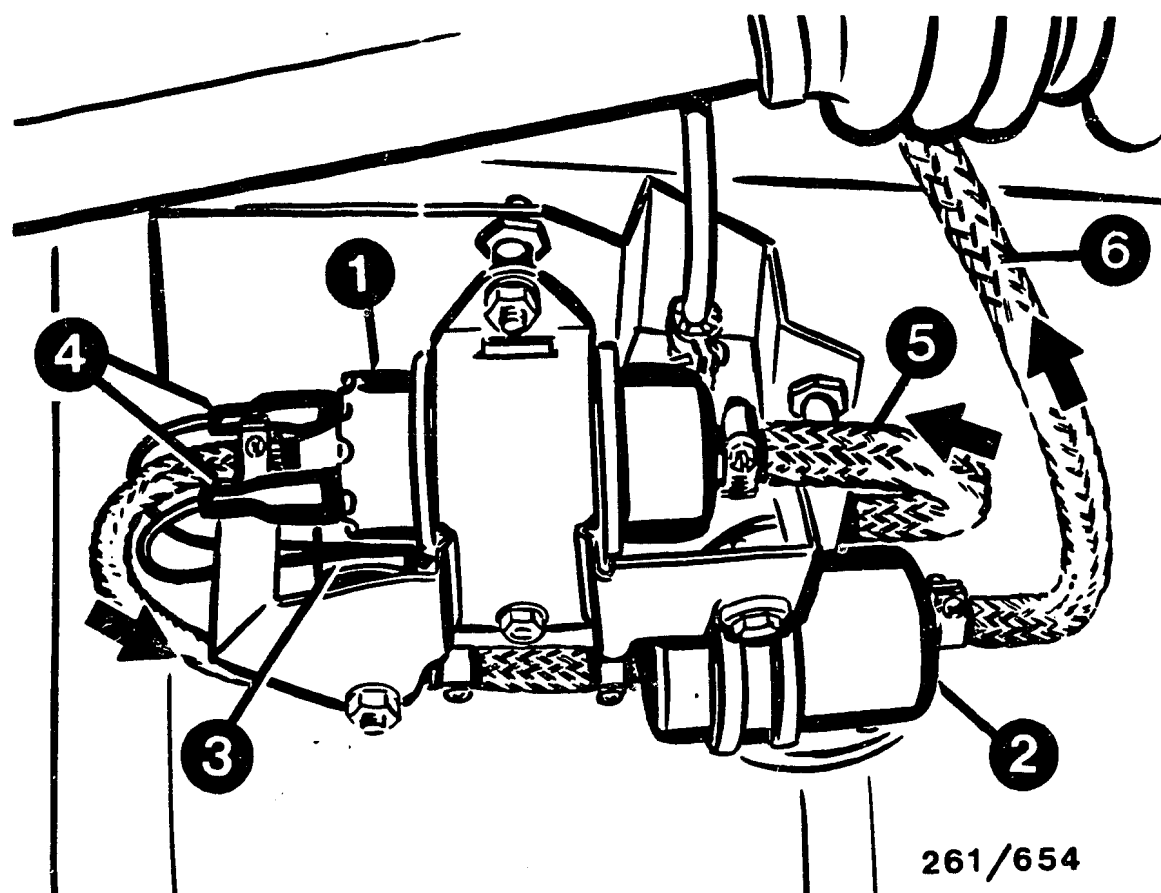


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INSTALLATION POSITION OF COMPONENTS

- 1 = Air-flow sensor
- 2 = Throttle-valve switch
- 3 = Activated-carbon canister
- 4 = Diagnostic plug
- 5 = Octane-rating encoding plug
- 6 = Rotary actuator

- 7 = Lambda-sensor plug-in connection
- 8 = Injection valves
- 9 = Engine-speed-sensor plug-in connection
- 10 = Tank-ventilation valve
- 11 = Temperature sensor (engine)
- 12 = Ignition coil
- 13 = High-voltage distributor

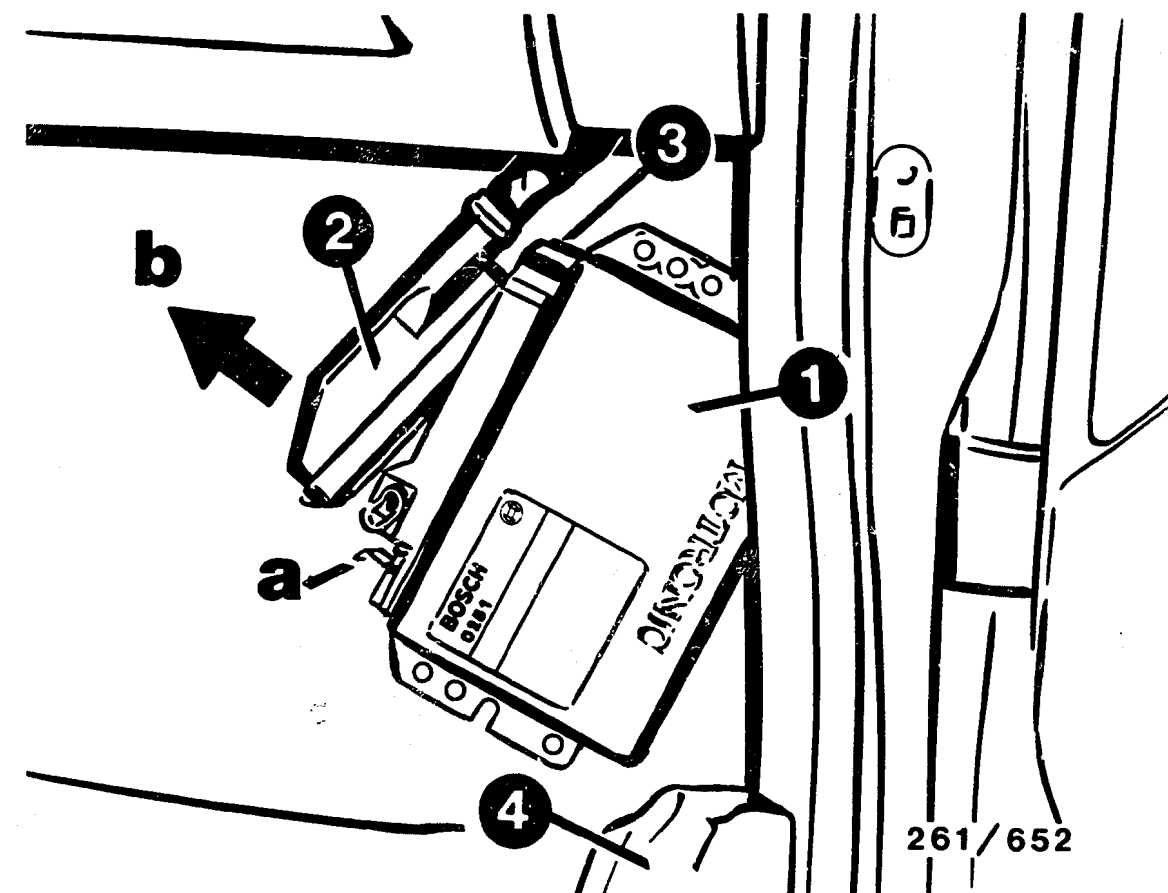


- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Pressure damper
- 4 = Electrical connections

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump and fuel filter:
In front of the fuel tank.
- * Ground terminal:
In engine compartment at front on left-hand side on the bodywork next to the battery.
- * Diagnostic plug:
In engine compartment on right-hand side on the firewall.
- * Octane-rating encoding plug:
In engine compartment on right-hand side of the firewall.

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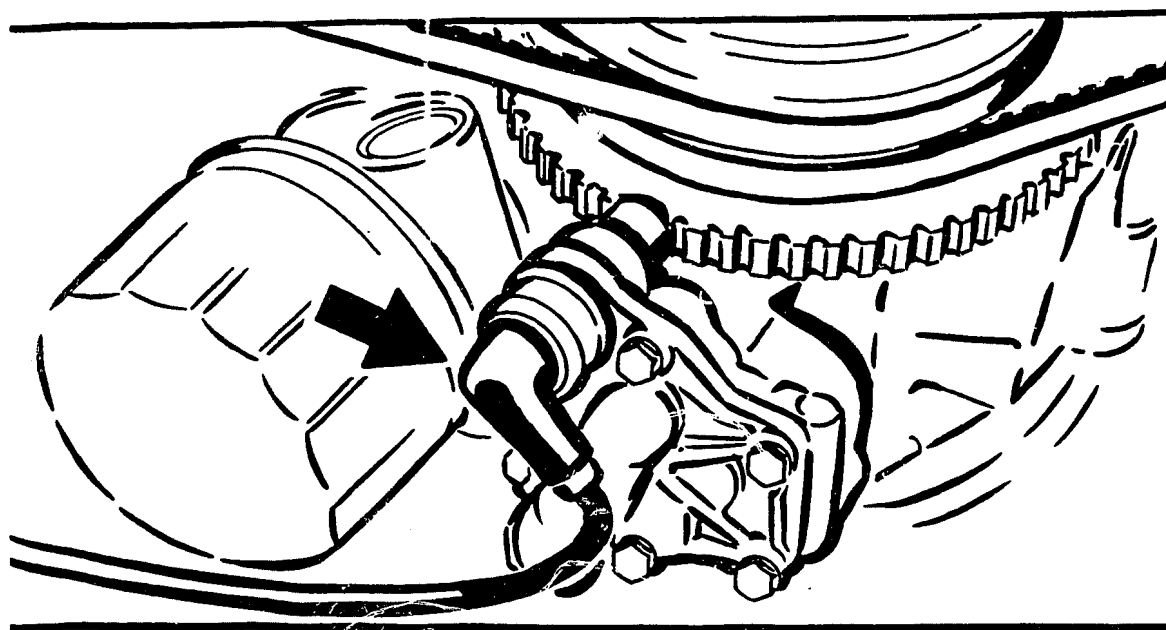
- 1 = Control unit
- 2 = Plug
- 3 = Mechanical encoding with lug
- 4 = Covering over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "right" and "left" always refer to the forward direction of travel.

- * Control unit:
In passenger-side footwell on the right. Slightly lift up rubber strip and cover on door sill. Lift up floor carpet to one side and remove control-unit cover. Unscrew control unit. Unlatch plug (a), fold back (arrow b) and unhook (Item 3).
- * Temperature sensor (engine):
On engine block at the front on the right, blue plug.

261/652

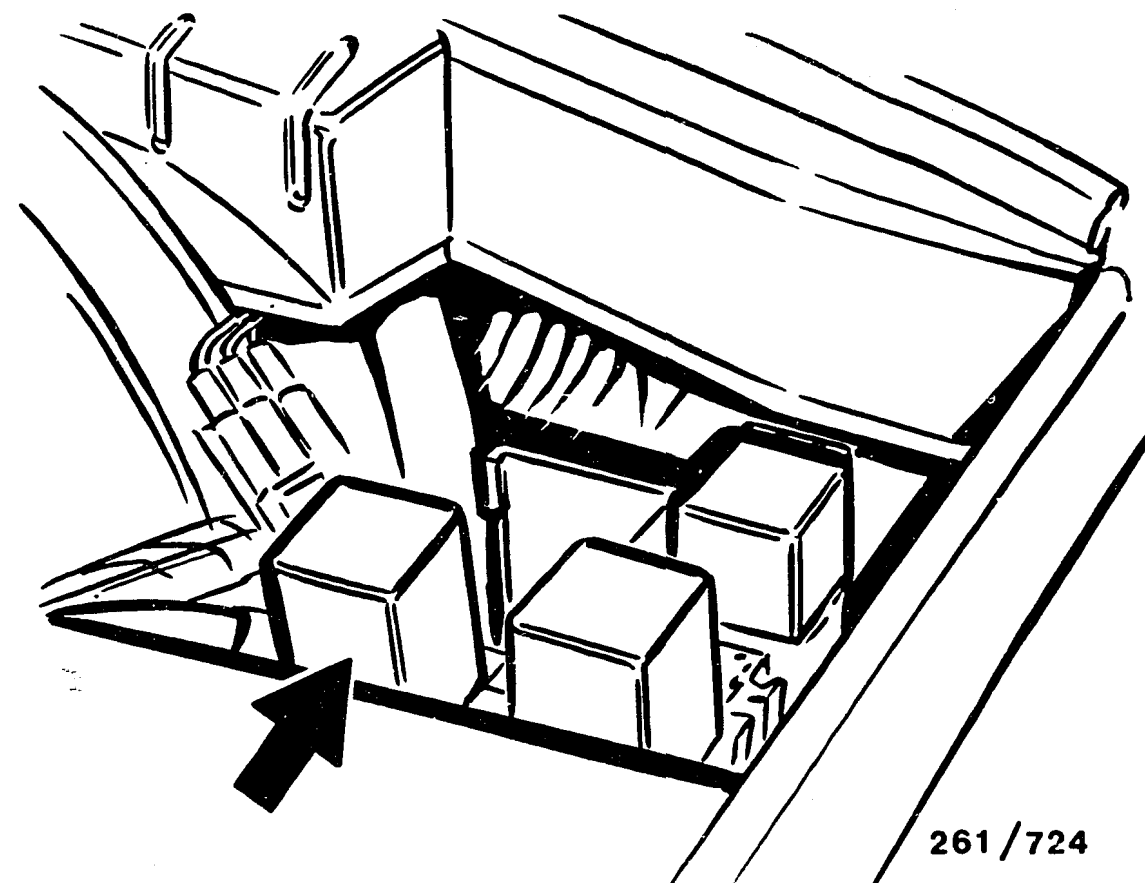


261/725

Arrow = Reference-mark / engine-speed sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Reference-mark/engine-speed sensor:
On oil-pump housing next to oil filter
(accessible from below).
- * Lambda sensor:
In common exhaust pipe upstream of the
catalytic converters.
- * Fuses:
In instrument panel, bottom left.
Fuse box can be tilted open at its
underside.
- * Temperature sensor (air):
In air-flow sensor



261/724

Arrow = Motronic relay

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Motronic relay:
In engine compartment on left-hand side in front of the
firewall.
- * Adjust ignition distributor:
Remove cap and protective cover from ignition
distributor.
Position cylinder 1 to ignition-timing
mark (pointer in inspection hole on cylinder
block points to ball in flywheel).
Center of ignition-distributor rotor must
point to marking on housing of cylinder 1.
If necessary, turn ignition-distributor housing;
to do this, loosen clamping strap.
- * Distance-travel frequency sensor:
At transmission output beneath vehicle.

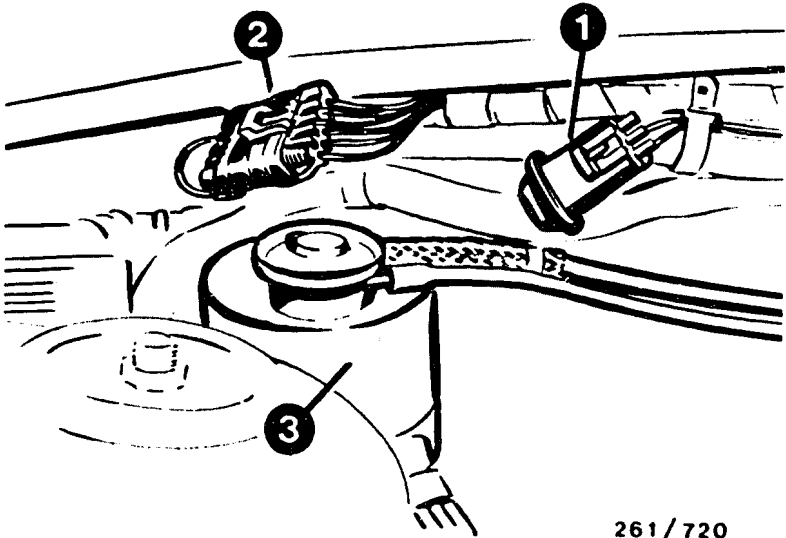
* Variant encoding

Octane-number adjustment with encoding plug.

Octane number	Resistance at term. 15 for 3 l engine, 130 kW with regulated catalytic converter
91 RON *)	0 Ω 1) Infinity Ω 2) 750 Ω 2)3)4)
95 RON	220 Ω 1) 1200 Ω 3) 2200 Ω 2) 4700 Ω 2)3)

*) 91 RON = Unleaded regular fuel
(only to be used in an emergency if 95 RON not available)
95 RON = Unleaded premium fuel

- 1) = Basic value (black plug).
- 2) = Idle speed is increased by 100 min ⁻¹ .
- 3) = Acceleration enrichment is enriched.
- 4) = Advance is -5.25 °CS (retard direction) over entire map range.



261/720

- 1 = Octane-rating encoding plug
- 2 = Diagnostic plug
- 3 = Activated-carbon canister

Vehicles with catalytic converter: term. 27
infinity Ω (open)

Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever position
P and N: zero Ω (via selection lever
to ground). In all other selection-lever
positions, term. 28 is open (infinity Ω)
If a driving position is engaged, the idle
speed is reduced if necessary as a function
of temperature, so as to avoid driving off.

Vehicles with air conditioner:
term. 29 to switch for defroster lever
(air-conditioner readiness).
term. 32 to switch for compressor.

Vehicles with distance-travelled frequency sensor
(speedo signal):
term. 26 connected to distance-travelled
frequency sensor.
Distance-travelled frequency sensor
is installed only in conjunction with the
on-board computer, LCD instrument
or electronic speedometer.

- * Vehicles with electronic transmission control (GS):
When shifting gear, the GS produces a brief ignition-
timing adjustment by way of the Motronic control unit.
There is thus less of a jerk when changing gear.
- * Ignition distributor is used only for H.T. distribution.
Setting required.
- * Air-flow sensor with bypass screw (no CO potentio-
meter). Adjustment of bypass screw has no effect, since
adaptive lambda closed-loop control system always
effects correction.

STRUCTURE AND USAGE

These brief instructions encompass essentially
vehicle-specific special features and test
specifications (set values).

In accordance with the customer complaint,
the trouble-shooting chart leads to different
causes/component faults.
For a detailed description of trouble-shooting,
see the information in the trouble-shooting
chart of the basic instructions.

ATTENTION: Even if reference is made to
basic instructions, the set values, terminal
assignments and special features of these
vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to
avoid damage to the engine, trigger boxes and
control units or to the ignition system,
observe the information in the basic instructions.

CAUTION!
High-performance ignition system with
dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals
may prove fatal (both on the primary and
secondary sides).

Avoid fuel injection and high-tension
flashover when testing compression!
Motronic relay is therefore to be
disconnected.

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

												Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*												Voltage at control unit
*												Sensor
*		*			*	*						Fuel pressure
*		*				*	*					Solenoid-operated injection valves
		*	*									Idle contact
					*							Full-load contact
	*	*	*	*	*	*						Air-flow sensor
	*	*	*									Idle actuator
*	*	*	*									Air-induction system
		*										Idle speed
*		*		*	*							Ignition coil
*		*	*	*	*							Primary signal
		*	*	*	*	*						Secondary pattern
*	*	*	*		*	*		*	*			Ignition point
		*										Exhaust gas
		*										Overrun cut-off
		*	*	*								Interference-suppression resistors
		*	*	*								Noise test
					*							Interference

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

							Cause (component fault)
*			*				Throttle valve
			*				Fuel delivery
*	*	*					Tank vent
	*	*					Lambda closed-loop control
*	*	*	*	*	*	* * *	Motronic control unit
		*	*				Electronic transmission control

SELF-DIAGNOSIS TEST TABLE

Pocket System Tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Term.	Set values
Data exchange not possible			Ignition on! Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply to control unit including term. 18 O.K. Leads and power supply O.K., however no fault output: control unit defective.	4, 12, 17, 18	_____
Lambda sensor Open circuit	13	1 3	Open circuit in lead to lambda sensor. Sensor defective.	24	_____
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short to ground.	13	_____
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Check temperature sensor and leads for open circuit (op. circ.) and short to positive (short to B+) Temperature-sensor resistance : at +15...+30°C : at approx. +80°C :	13, ground	1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Check lead for short to ground. Watch out for worn insulation! Severe leaning, e.g. tank emptied. Leak in exhaust between engine and lambda sensor.	24	_____
Lambda sensor Short to B+	45	4 5	Check lead for short to positive (short to B+) Watch out for worn cable insulation! Mixture too rich.	24	_____
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Check voltage dips at positive and ground terminal. Charge battery. Check alternator system.	35(+), 5(-)	greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Check alternator regulator.	35(+), 5(-)	less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Termi- nals	Set values
Control unit Digital sec. (comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
Idle switch Short to ground	7	6 7	Fault: Idle contact (in throttle-valve switch or sensor) permanently closed or short to ground in lead. Idle contact closed in off-position: Actuate throttle valve somewhat: in the event of increased idling speed or "hunting": idle actuator or control unit defective.	2, Ground	approx. 0 Ω infinity Ω
Air-temp. sensor Short to ground	69	6 9	Check temperature sensor and lead for short to ground.	22	—
Air-temp. sensor Open circuit	71	7 1	Check temperature sensor and leads for open circuit. Temperature-sensor resistance: at +15°C...+30°C:	22, 6(-)	1450...3300 Ω
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch or sensor) permanently closed. Fault lamp only lights up occasionally during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	approx. 0 Ω infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions / Test conditions	Termi- nals	Set values
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Check: Lead to air-flow sensor term. 2 for short to ground, leads to term. 2 and term. 3 for open circuit, leads to term. 3 and term. 4 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	—
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Check: Lead to air-flow sensor term. 4 for open circuit. Leads to term. 2 and term. 4 for short to positive (5V or battery positive). Check resistances of air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4 : Air-flow sensor defective.	6(-), 7	8...2500 Ω 500...1100 Ω
Transmission identification Short to ground	75	7 5	Check lead for short to ground. Transmission control unit (if fitted) defective. Continue testing with electronic transmission control.	8	—
No fault stored		1 2	Flashing code 1-2 is constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	—

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,8...3,2 bar
Electric fuel pump	
* Fuel delivery (measured in return)	at least 850 cm ³ /30s
Supply voltage (under load):	at least 12 V
Temperature sensor (air)	
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 1 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine), blue plug.	
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C):	280....360 Ω
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17,5 Ω
Air-flow sensor	
* Internal electrical resistance between:	
term. 2 and term. 4 :	8...2500 Ω (1)
term. 3 and term. 4 :	500...1100 Ω

- (1) Deflect air-flow sensor flap slowly as far as it will go.
Resistance increases in an unsteady manner and drops off slightly towards end.

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor	
* Internal resistance at ambient temperature (+15°C...+30°C):	400...800 Ω
* Air gap:	0,8 ± 0,5 mm
Throttle-valve switch or sensor	
* Resistance value of idle contact (term.2 and term.18 or term.6 and term.4):	approx. 0 Ω
* Resistance value of full-load contact (term.3 and term.18 or term.5 and term.4):	approx. 0 Ω
Pressure sensor (altitude sensor) (if fitted)	
* Overall resistance between term.3(+) and term.2(-) :	2300...2500 Ω
* Resistance between wiper term.1(S) and term.2(-) :	400...2300 Ω
Test specification is a function of altitude	
Idle actuator	
* Internal resistance at +15°...+30°C :	approx. 8 Ω
Lambda sensor	
* Resistance value of heater winding	1...15 Ω
Ignition coil	
* Primary resistance	approx. 0 Ω
* Secondary resistance	6400...11100 Ω
Interference-suppression resistors	
* H.T. distributor rotor:	1 k Ω
The secondary side of the ignition system must feature interference suppression with at least 5 k Ω overall resistance. H.T. resistance leads are fitted as standard.	

TEST SPECIFICATIONS (CONTINUED)

Idle test:

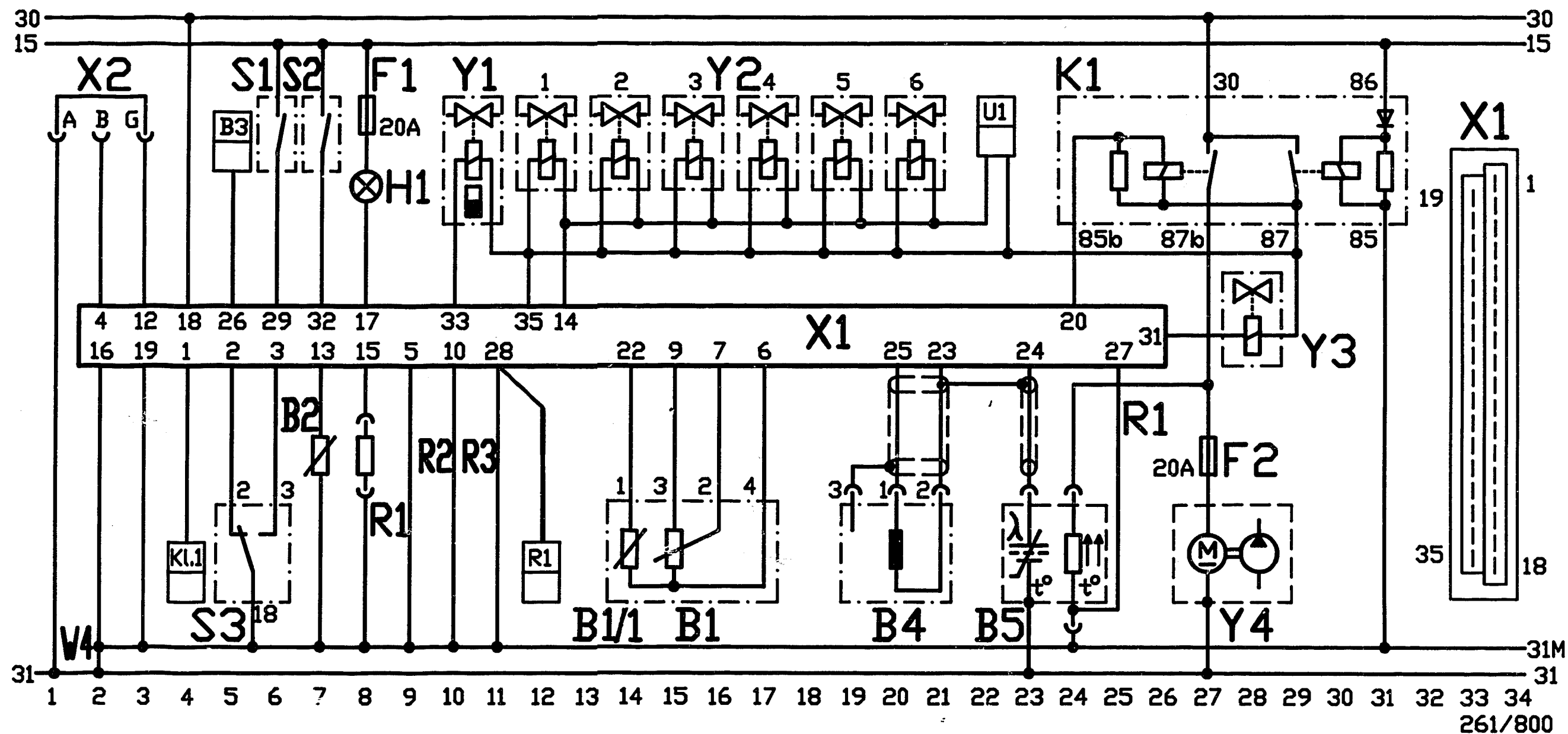
- Engine at normal operating temperature, switch off loads.
- * Idle speed: 670...830 min -1 +)
- * Spark-advance angle: 10 ± 5 ° crankshaft +)

Automatic transmission to N or P

+) Attention! The basic values stated may deviate due to variant encoding. Pay attention to table in "Special Features" section.

See equipment and Autodata microcards for settings for valve clearance and other engine-related data.

For production reasons:
continued on the following
coordinate.

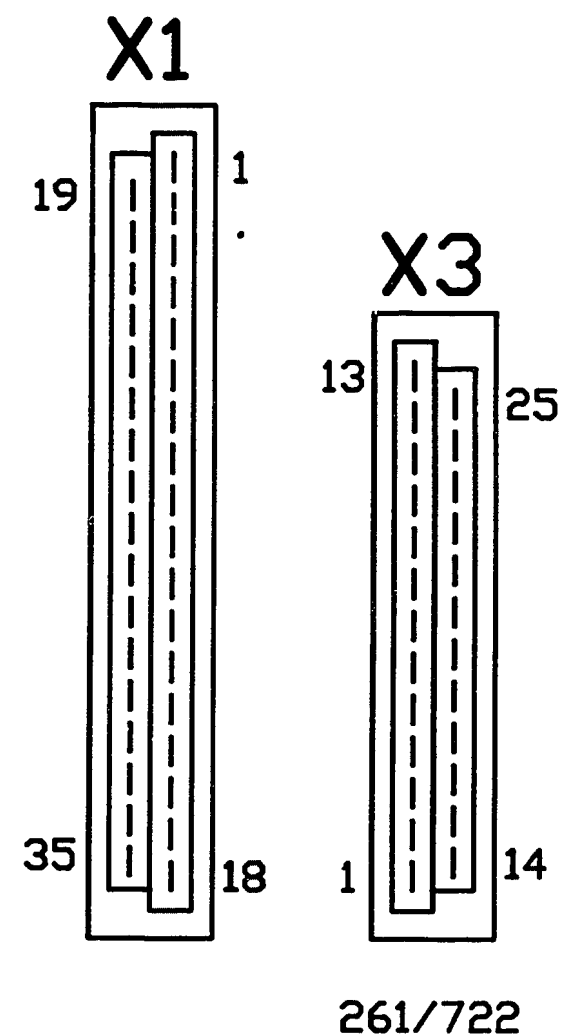
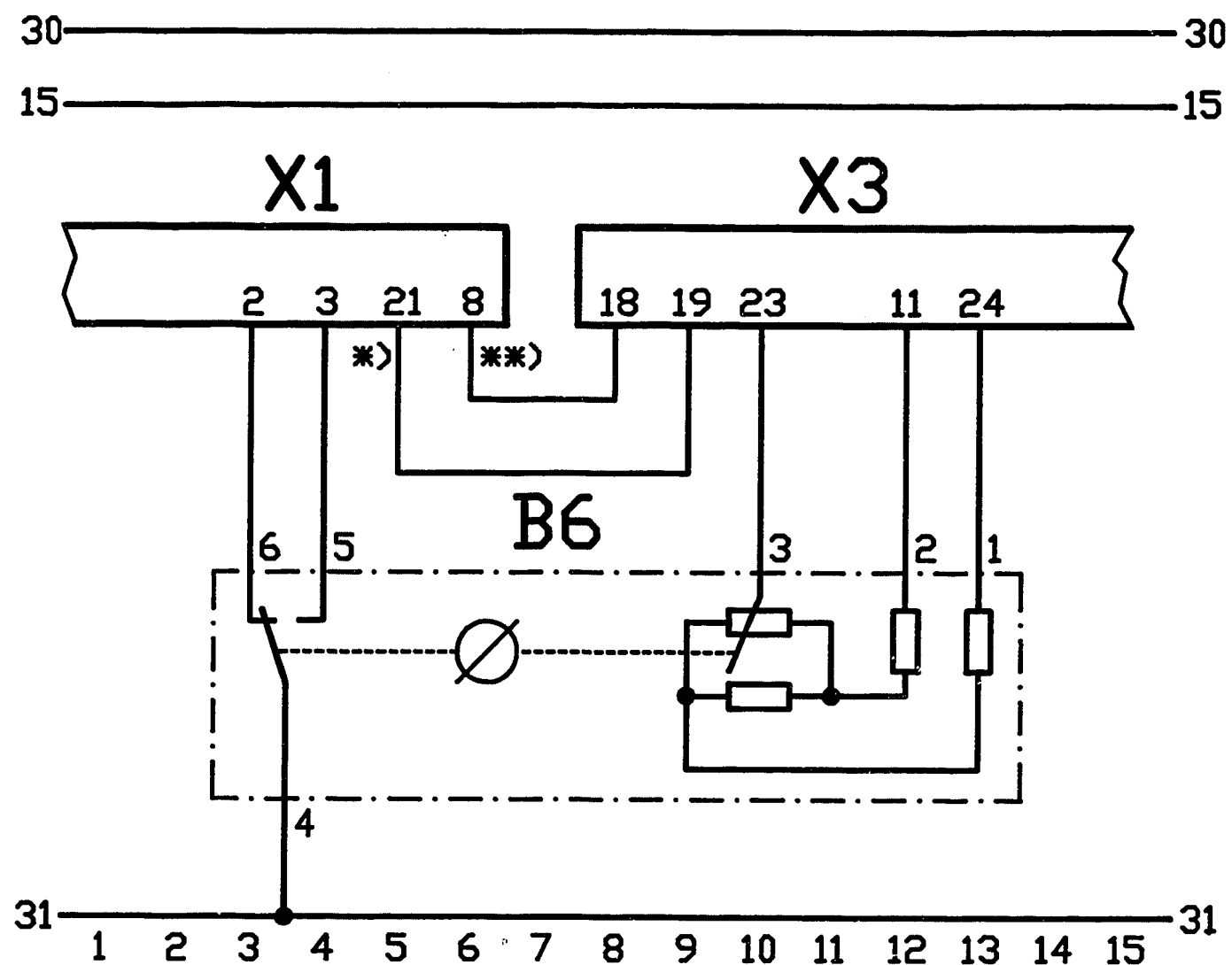


ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
 B1/1= Temperature sensor (air)
 B2 = Temperature sensor (engine)
 B3 = Distance travelled sensor
 B4 = Lambda sensor
 B5 = Eng.-speed/ref.-mark sensor
 F1,F2 = Fuse 20A

H1 = Fault lamp
 K1 = Motronic relay
 Term. 1 = Ignition coil term. 1
 R1 = See variant coding
 R2 = For automatic transm. only
 R3 = For man. shifted transm. only
 S1 = Switch, compressor
 S2 = Air conditioner
 S3 = Throttle-valve switch

U1 = On board computer
 W4 = Ground strap, engine
 X1 = Motronic control-unit plug
 X2 = Diagnostic plug
 Y1 = Injection valve
 Y2 = Tank bleeder valve
 Y3 = Idle actuator
 Y4 = Electric fuel pump



B6 = Throttle-valve switch
with potentiometer for
electronic transmission
control

X1 = Motronic control-unit plug

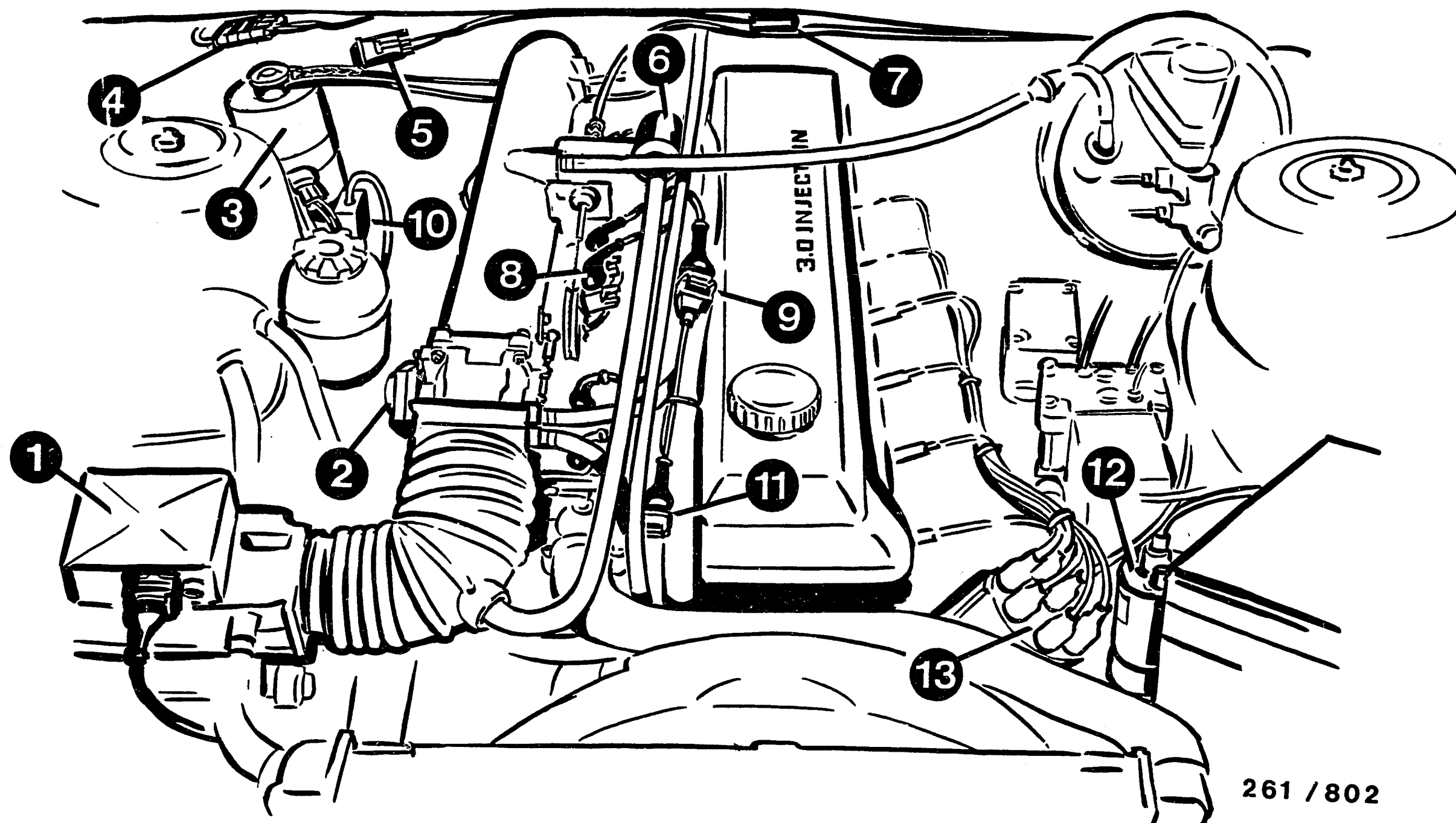
X3 = Transmission control-unit plug

*) = Output for engine speed

**) = Input for engine action

ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

Deviations for vehicles with electronic transmission control

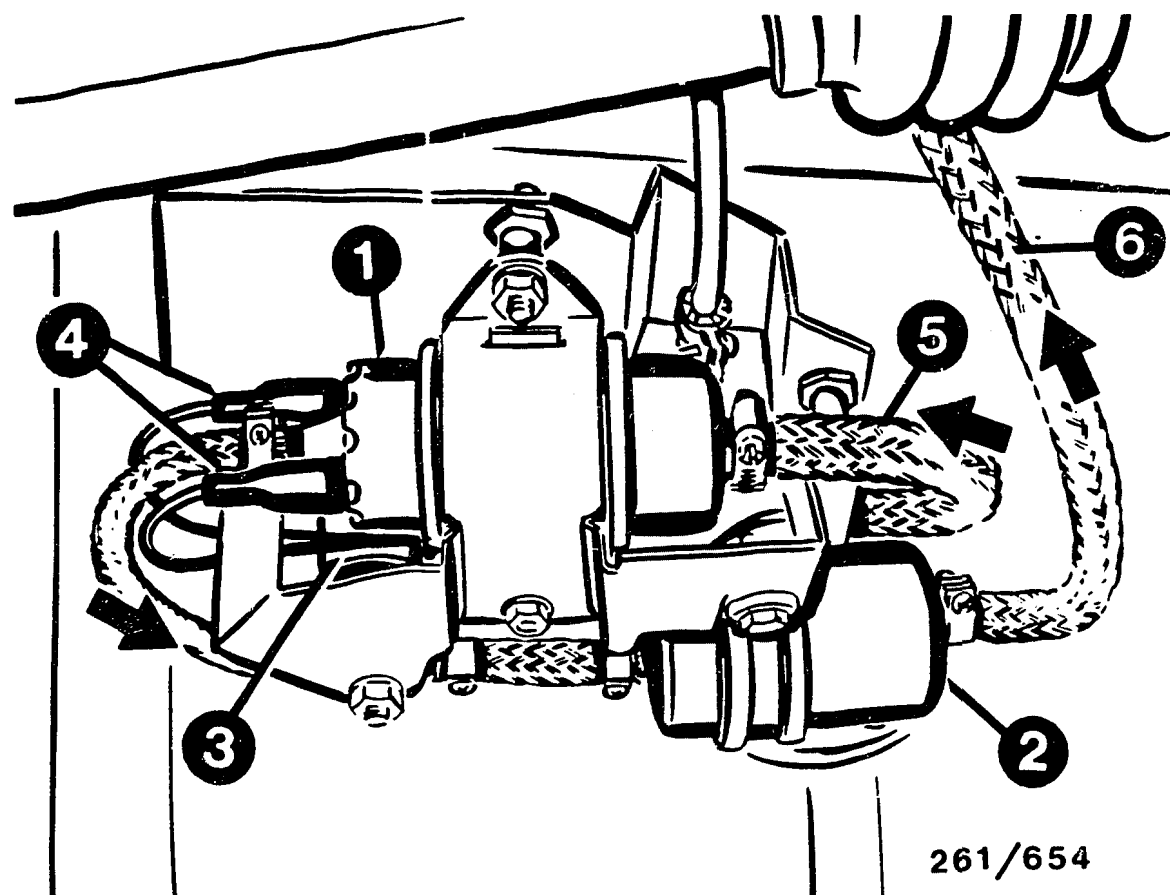


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INSTALLATION POSITION OF COMPONENTS

- 1 = Air-flow sensor
- 2 = Throttle-valve switch
- 3 = Activated-carbon canister
- 4 = Diagnostic plug
- 5 = Octane-rating encoding plug
- 6 = Rotary actuator

- 7 = Lambda-sensor plug-in connection
- 8 = Injection valves
- 9 = Engine-speed-sensor plug-in connection
- 10 = Tank-ventilation valve
- 11 = Temperature sensor (engine)
- 12 = Ignition coil
- 13 = High-voltage distributor

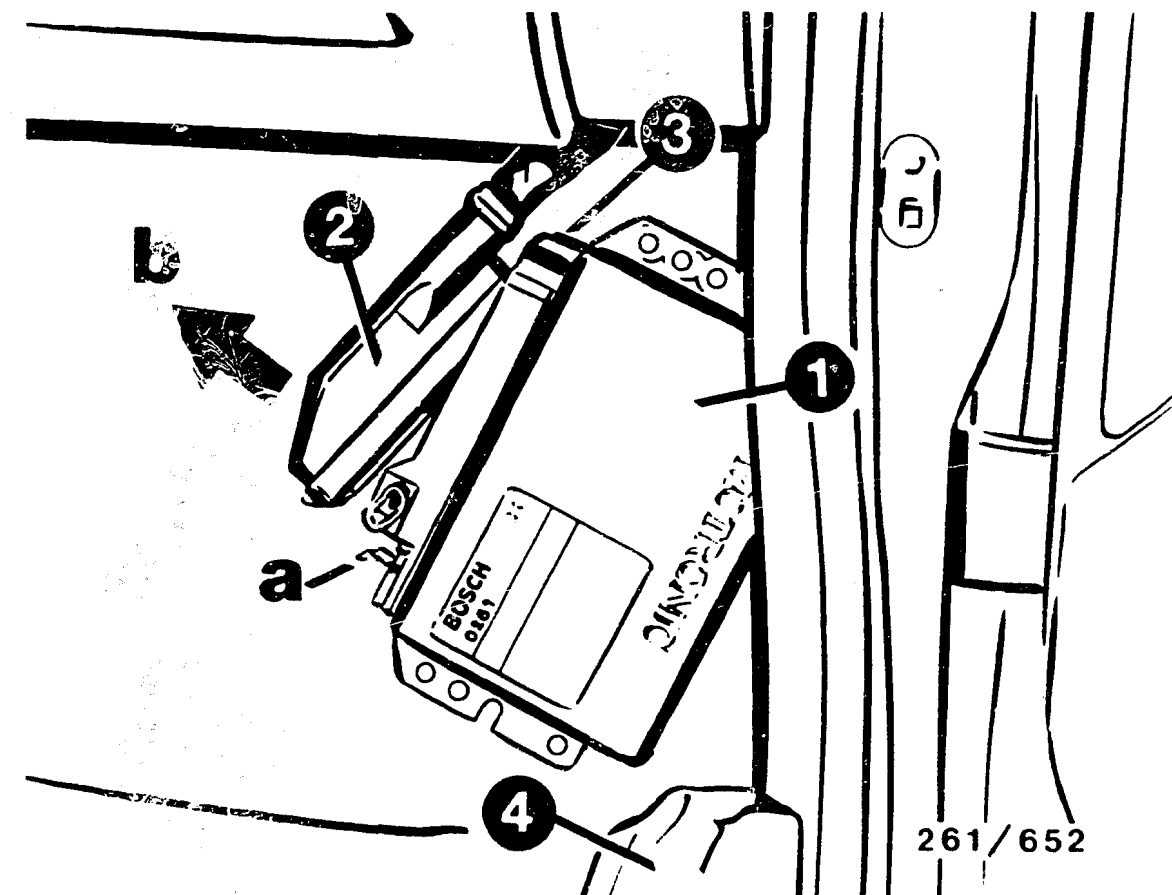


- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Pressure damper
- 4 = Electrical connections

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Electric fuel pump and fuel filter:
in front of the fuel tank.
- * Ground terminal:
In engine compartment at front on left-hand side on the bodywork next to the battery.
- * Diagnostic plug:
In engine compartment on right-hand side on the firewall.
- * Octane-rating encoding plug:
In engine compartment on right-hand side of the firewall.

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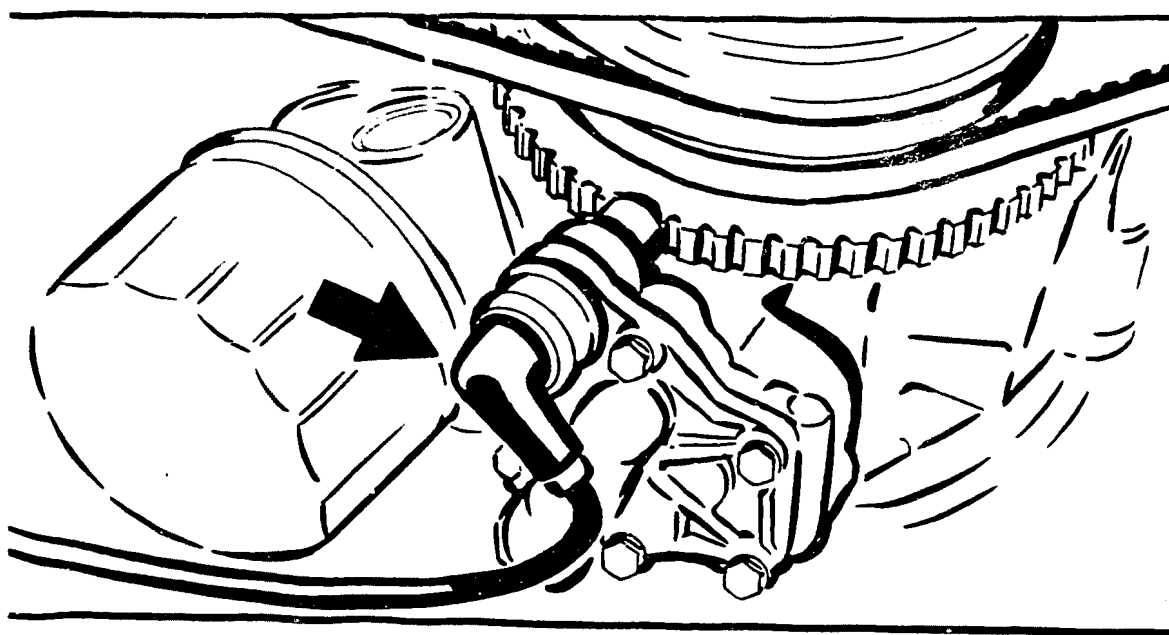
- 1 = Control unit
- 2 = Plug
- 3 = Mechanical encoding with lug
- 4 = Covering over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "right" and "left" always refer to the forward direction of travel.

- * Control unit:
In passenger-side footwell on the right. Slightly lift up rubber strip and cover on door sill. Lift up floor carpet to one side and remove control-unit cover. Unscrew control unit. Unlatch plug (a), fold back (arrow b) and unhook (Item 3).
- * Temperature sensor (engine):
On engine block at the front on the right, blue plug.

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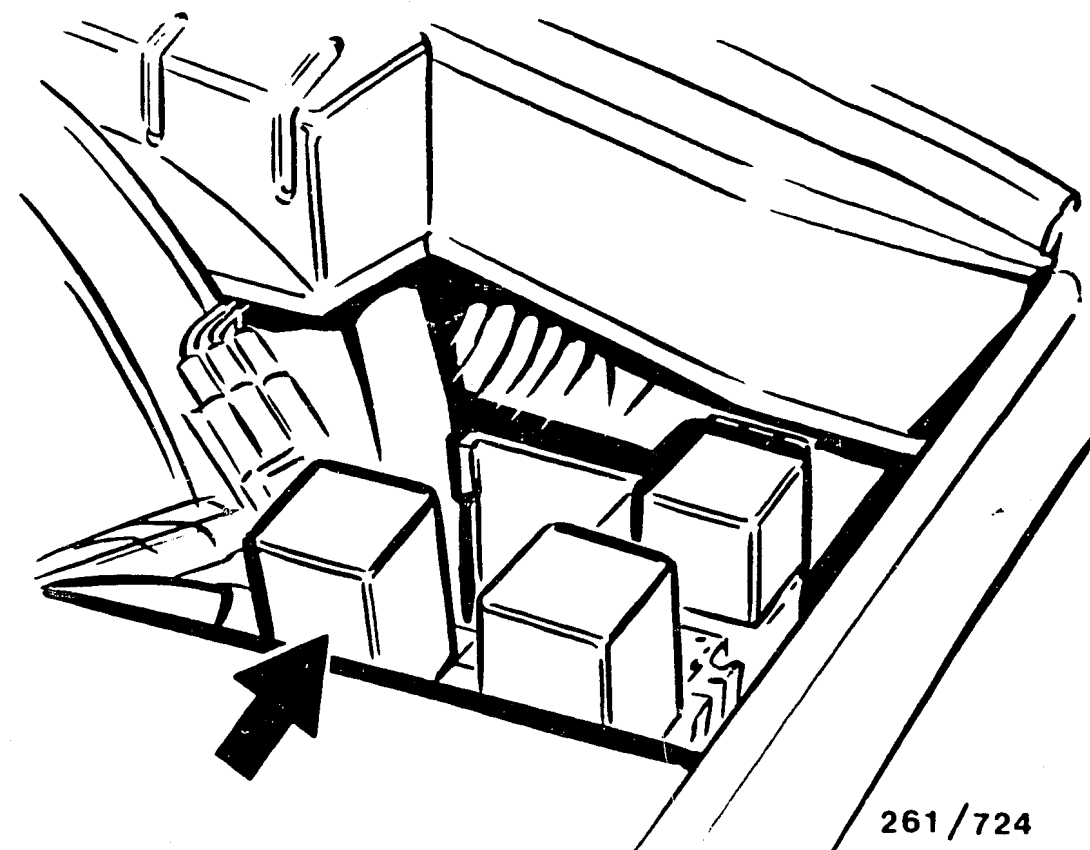


261/725

Arrow = Reference-mark / engine-speed sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Reference-mark/engine-speed sensor:
On oil-pump housing next to oil filter
(accessible from below).
- * Lambda sensor:
In common exhaust pipe upstream of the
catalytic converters.
- * Fuses:
In instrument panel, bottom left.
Fuse box can be tilted open at its
underside.
- * Temperature sensor (air):
In air-flow sensor



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Arrow = Motronic relay

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Motronic relay:
In engine compartment on left-hand side in front of the
firewall.
- * Adjust ignition distributor:
Remove cap and protective cover from ignition
distributor.
Position cylinder 1 to ignition-timing
mark (pointer in inspection hole on cylinder
block points to ball in flywheel).
Center of ignition-distributor rotor must
point to marking on housing of cylinder 1.
If necessary, turn ignition-distributor housing;
to do this, loosen clamping strap.
- * Distance-travel frequency sensor:
At transmission output beneath vehicle.

Trouble-shooting instructions : OPE-5021
BOSCH system : Motronic M 1.5
Make of vehicle : OPEL
Basic microcard : KFZ-00..

TABLE OF CONTENTS

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Self-diagnosis test table	E11
Test specifications	E21
Electrical terminal diagram	E25
Installation position of components, notes on removal and installation	F03

SPECIAL FEATURES

- These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:
- OPEL Omega (09.88 ->)
OPEL Senator B (09.88 ->)
with 2.4 l / 4-cylinder engine,
engine type CIH, C 24 NE with catalytic converter
- * Motronic M 1.5 with self-diagnosis
 - * The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 10.89.

Note:
Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).
 - * As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).
 - * Control unit with 55-pole plug
 - * Air-flow sensor with CO potentiometer.
CO potentiometer has no effect in the case of vehicles with lambda closed-loop control.
 - * Joint sensor for engine speed and reference mark
 - * Single-winding rotary actuator
 - * Lambda closed-loop control

- * Throttle-valve sensor with no idle and full-load contact. Idle and full load are detected by way of wiper voltage. This has the advantage, for example, of better self-diagnosis and precise information concerning the position of the throttle valve.
- * Ignition distributor is used only as H.T. distributor. Adjustment required.
- * In-tank pump as of 9.88 (with the exception of Kombi vehicles)
- * Note on pressure testing:
The system pressure is identical with engine stopped and engine running.
Reason: the connection to the pressure regulator on the air end is connected upstream of the throttle valve, so as to avoid hot-starting problems.

* Variant encoding

Variant encoding for adaptation to country versions and different levels of equipment as well as for influencing engine speed and mixture.

Input term. 20 (country variant) open.

Octane number adaptation with encoding plug:

Octane number	Resistance at term. 46 for 2.4 l engine, 92 kW with regulated catalytic converter		
91 RON *)	0 Ω	1)	
	infinity Ω	2)	
	750 Ω	2)3)4)	
95 RON	220 Ω	1)	
	1200 Ω	3)	
	2200 Ω	2)	
	4700 Ω	2)3)	

*) 91 RON = unleaded regular gasoline (only to be used in an emergency if 95 RON not available).

95 RON = unleaded premium gasoline

- 1) Basic value, black encoding plug
- 2) Idle speed is increased by 100 min -1
- 3) Acceleration enrichment is made richer.
- 4) Ignition timing is -5.25 °CS (in retarded direction) over entire map range.

Vehicles with manual transmission:

Term. 21 infinity Ω (open)
Term. 42 zero Ω (to ground)

Vehicles with automatic transmission:

Term. 21 zero Ω (to ground)
Term. 42 in selector-lever settings P and N: zero Ω (by way of selector lever to ground).
In all other selector-lever positions term. 42 is open (infinity Ω).
If a driving position is engaged, the idle speed is reduced as a function of temperature if necessary, so as to avoid driving off.

Vehicles with A/C:

Term. 41 to switch for defroster lever (A/C readiness).
Term. 40 to switch for compressor.

* Modified tank ventilation system:

Instead of a switched tank ventilation valve, use is now made of a pulsed valve. The on/off ratio is altered by way of a map in the control unit depending on the operating condition of the engine. Better metering of the fuel vapors supplied is guaranteed. For example, the lambda closed-loop control system does not move to the control stop in the event of an excessive amount of fuel vapor.

After switching off the ignition, the main relay controlled by the control unit drops out following a time delay, so as to keep the valve closed and in order to avoid run-on (dieselling).

Check tank ventilation valve:

* Valve is pulsed with engine running.

* Check resistance of winding.

* Check for leaks:

Connect up vacuum pump on intake manifold end.

** Vacuum cannot be built up when no current is being applied.

** Seal off other connection. Generate 0.5 bar vacuum. No drop in pressure is permitted.

** Connect valve to battery voltage.

Generate 0.5 bar vacuum.

Pressure drop to 0.25 bar in approx. 10 seconds is permitted.

Check voltage supply (Motronic relay) to control unit.

- * Switch off ignition.
- * Detach control-unit plug.

1. Connect voltmeter to term.18 (+) and term.19 (-).

- * Switch on ignition.

Set value: battery voltage.

If set value is not obtained:

- * Check positive lead to B+.
- * Check ground lead and ground terminal.

2. Jumper term.19 and term.36 at connector.

- * Connect voltmeter to term.37 (+) and term.19 (-).

Set value: battery voltage.

If set value is not obtained:

- * Check following leads to Motronic relay:
 - * From B+ to term.30 and term.86.
 - * From control-unit plug term.36 and term.37 to term.85 and term.87 respectively.

- * Motronic relay defective.

- * If leads, plug connections and relays are OK and the voltage supply still does not function, control unit defective.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!

Motronic relay is therefore to be disconnected.

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

											Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage supply, relay
*											Engine-speed/reference-mark sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*		*						Throttle-valve sensor
		*	*	*	*	*	*				Air-flow sensor
		*	*	*							Idle actuator
*	*	*	*								Air intake system
		*									Idle speed
*		*			*	*					Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
				*							Ignition distributor adjustment
		*									Emissions
		*									Overrun cutoff
		*	*	*							Interference-suppression resistors
					*						Interference
					*						Lead shielding (see terminal diagram): visual inspection, check ground connection.

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

									Cause (component fault)
	*			*					Throttle valve
				*					Fuel delivery
	*	*	*						Tank vent
		*	*						Lambda closed-loop control
*	*	*	*	*	*	*		* * *	Motronic control unit
			*	*					Electronic transmission control

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Data exchange not possible			Ignition on; fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug or to fault lamp as well as power supply to control unit including term. 18 O.K. Leads and power supply O.K., however no fault output: control unit defective.	13, 18, 22	_____
Lambda sensor Open circuit	13	1 3	Check leads to lambda sensor for open circuit.	10(-), 28	_____
Engine temp. sensor Short to ground	14	1 4	Check temperature sensor and lead for short circuit to ground.	45	_____
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Check temperature sensor and leads for open circuit (Op. circ.) and short circuit to positive (sh. to B+). Temperature-sensor resistance : at +15...+30°C : at approx. +80°C : Note: Fault is only detected if it occurs with engine running.	45, ground	1450...3300 Ω 280....360 Ω
Eng.-speed signal incorrect/no signal	19	1 9	Fault is detected with engine running as of a certain engine speed. Causes: ring gear defective (e.g. tooth damaged). Check sensor and leads for loose contact, open circuit, short to ground and short to positive. Measure sensor resistance: at +15...+30°C :	47, 48, shield	Pulse pattern (see test specifications) 400...800 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Throttle-valve sensor Signal too high	21	2 1	Check potentiometer, negative lead and wiper lead for open circuit. Check leads for short circuit to battery/supply voltage (5V). Measure resistance of potentiometer.	12(+), 26(-), 53	Between term.1 and term.3, idle setting: 750...1400 Ω Full-load setting: 1850...3300 Ω Overall resistance between term.1 and term.2: 1.6...2.4 k Ω
Throttle-valve sensor Signal too low	22	2 2	Check potentiometer and leads for open circuit. Check leads for short to ground. Measure resistance of potentiometer.	12(+), 53	
Injection valves/ injection valve, cyl1 Short to B+	25 1)	2 5 1)	Check leads from control unit to injection valves for short circuit to positive (short to B+). Reference to cylinder 1 does not apply to this vehicle. Watch out for worn insulation! Resistance of injection valve:	16, 17	14.5...17.5 Ω
Eng. speed signal at cranking speed defective	31	3 1	With ignition on, a fault is stored since there is no signal as yet. Start engine and do not switch off ignition (if applicable, leave engine running). Re-initiate diagnosis. Fault code 31 is cleared if engine starts on cranking. If no adequate signal is recognized during starting, fault code 31 remains set. (Engine doesn't start). Measure pulse pattern and air gap: Measure sensor resistance: Check lead for open circuit and short circuit to ground. Watch out for worn insulation! Air gap too large. Ring gear defective.	47, 48	Pulse pattern 0.8 \pm 0.5 mm 400...800 Ω
Lambda sensor Short to ground	38/ 44	3 8/ 4 4	Check lead for short circuit to ground (short to ground). Watch out for worn insulation! Pronounced leaning, e.g. tank run empty.	28	—

1) Fault code contained in control unit as of 09.89.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Lambda sensor Short to B+	39/ 45	3 9/ 4 5	Check lead for short circuit to positive (short to B+). Watch out for worn insulation! Mixture too rich.	28	_____
Battery voltage too low	..8	4 8	Supply voltage for control unit too low (with engine running): Check voltage dips at positive and ground terminal. Charge battery. Check alternator system.	37(+), 19(-)	greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): check alternator regulator.	37(+), 19(-)	less than 16 V
Control unit Digital sec.(comput) defective	51/ 55	5 1/ 5 5	Control unit defective. Note: Given flashing code 55 additionally check: leads and plug connections to knock sensor. Knock sensor defective.	_____	_____
Fault ind. light Short to B+	52 1)	5 2 1)	Check lead for short circuit to positive (short to B+). Watch out for worn insulation!	22	_____
Relay Fuel pump Op.circ/Ground short	53 1)	5 3 1)	Check lead to relay term. 85b for open circuit (Op.circ) and short circuit to ground (ground short). Watch out for worn insulation and loose contacts. Replace relay.	3	_____
Relay Fuel pump Short to B+	54 1)	5 4 1)	Check lead to relay term. 85b for short to positive (short to B+). Watch out for worn insulation and loose contacts. Replace relay.	3	_____
1-winding rotary idle actuator Op.circ/Ground short	56 1)	5 6 1)	Check leads to actuator and actuator winding for open circuit (Op.circ) and short circuit to ground (Ground short). Watch out for worn insulation. Resistance of actuator winding:	4	approx. 8 Ω
1-winding rotary idle actuator Short to B+	57 1)	5 7 1)	Check lead to actuator and actuator winding for short circuit to positive (short to B+). Watch out for worn insulation. Resistance of actuator winding:	4	approx. 8 Ω

1) Fault code contained in control unit as of 09.89

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Valve Tank ventilation Short to ground	61 1)	6 1 1)	Check lead to valve and valve itself for short to ground. Watch out for worn insulation. Resistance of valve winding:	5	approx. 28 Ω
Valve Tank ventilation Short to B+	62 1)	6 2 1)	Check lead to valve and valve itself for short circuit to positive (short to B+). Watch out for worn insulation. Resistance of valve winding:	5	approx. 28 Ω
Air-temp. sensor Short to ground	69	6 9	Check temperature sensor and lead for short to ground.	22	—
Air-temp. sensor Open circuit	71	7 1	Check temperature sensor and leads for open circuit. Temperature-sensor resistance: at +15°C...+30°C:	22, 6(-)	1450...3300 Ω
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Check: Lead to air-flow sensor term. 2 for short to ground, leads to term. 2 and term. 3 for open circuit, leads to term. 3 and term. 4 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	—
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Check: Lead to air-flow sensor term. 4 for open circuit, leads to term. 2 and term. 4 for short circuit to positive (5V or battery positive). Check resistances of air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω

1) Fault code contained in control unit as of 9.89.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Transmission identification Short to ground	75	7 5	Check lead for short to ground. Transmission control unit (if fitted) faulty. Continue testing with electronic transmission control.	8	—
Injection valves/ injection valve, cyl1 Op.circ/Ground short	81 1)	8 1 1)	Check leads from control unit to injection valves and injection valves themselves for open circuit (Op.circ) and short to ground (Ground short). Reference to cylinder 1 does not apply to this vehicle. Check leads from relay term. 87 to injection valves and to control unit term. 37 for open circuit (Op.circ). Watch out for worn insulation! Resistance of injection valve:	16, 17	14.5...17.5 Ω
Compressor cutoff relay Short to ground	87 1)	8 7 1)	Check lead to relay term. 85 for short to ground. Watch out for worn insulation. Replace relay.	40	—
Compressor cutoff relay Short to B+	88 1)	8 8 1)	Check lead to relay term. 85 for short to positive (short to B+). Watch out for worn insulation. Replace relay.	40	—
No fault stored	—	1 2	Flashing code 1-2 is constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	—

1) Fault code contained in control unit as of 09.89.

TEST SPECIFICATIONS

Pressure regulator

* Fuel pressure 2,8...3,2 bar

Electric fuel pump

* Delivery
(measured in return line) min. 900 cm³ /30s
Supply voltage
(under load): min. 12 V

Temperature sensor (intake air)

* Internal resistance
measured at air-flow sensor
between term. 4 and term. 5
at ambient temperature
(+15°C...+30°C): 1450...3300 Ω

Temperature sensor (engine), plug color, blue.

* Internal resistance
at ambient temperature
(+ 15° C...+ 30° C): 1450...3300 Ω
engine at operating temperature
(approx. + 80° C): 280... 360 Ω

Solenoid-operated injection valve

* Internal resistance
at ambient temperature
(+ 15° C...+ 30° C): 14,5...17,5 Ω

Air-flow sensor

* Internal resistance between:
term. 2 and term. 4 : 8...2500 Ω (1)
term. 3 and term. 4 : 300... 550 Ω
term. 1 and term. 4 (CO potentiometer):
Minimum 0... 30 Ω
Maximum: the actual value measured between
term. 3 and term.4 may be up to
30 Ω less.

(1) Slowly deflect air-flow sensor flap as far
as it will go.
Fluctuating increase in resistance; slight
decrease towards end.

TEST SPECIFICATIONS (CONTINUED)

Engine-speed sensor and reference-mark sensor

* Internal resistance
at ambient temperature
(+15°C...+30°C): 400...800 Ω
* Air gap: 0,8 ± 0,5 mm

Throttle-valve sensor

* Resistance at idle stop between
term.1 and term.3: 750...1350 Ω
* Slowly turn sensor shaft as
far as full-load stop.
Resistance at full-load stop: 1980...3300 Ω
* Overall resistance between
term.1 and term.2: 1600...2400 Ω

Idle actuator

* Internal resistance
at +15°...+30° C : approx. 8 Ω

Lambda sensor

* Resistance of heater winding 1...15 Ω

Ignition coil

* Primary resistance 0,6...1,0 Ω
* Secondary resistance 6400...11000 Ω

Interference-suppression resistors

* H.T. distributor rotor: 1 k Ω

The secondary side of the ignition system must feature
at least 4 k Ω overall resistance.
H.T. resistance leads are fitted as standard.

Tank ventilation valve (non-Bosch)

* Internal resistance
at +15°C...30°C : approx. 28 Ω

TEST SPECIFICATIONS (CONTINUED)

Idle check:

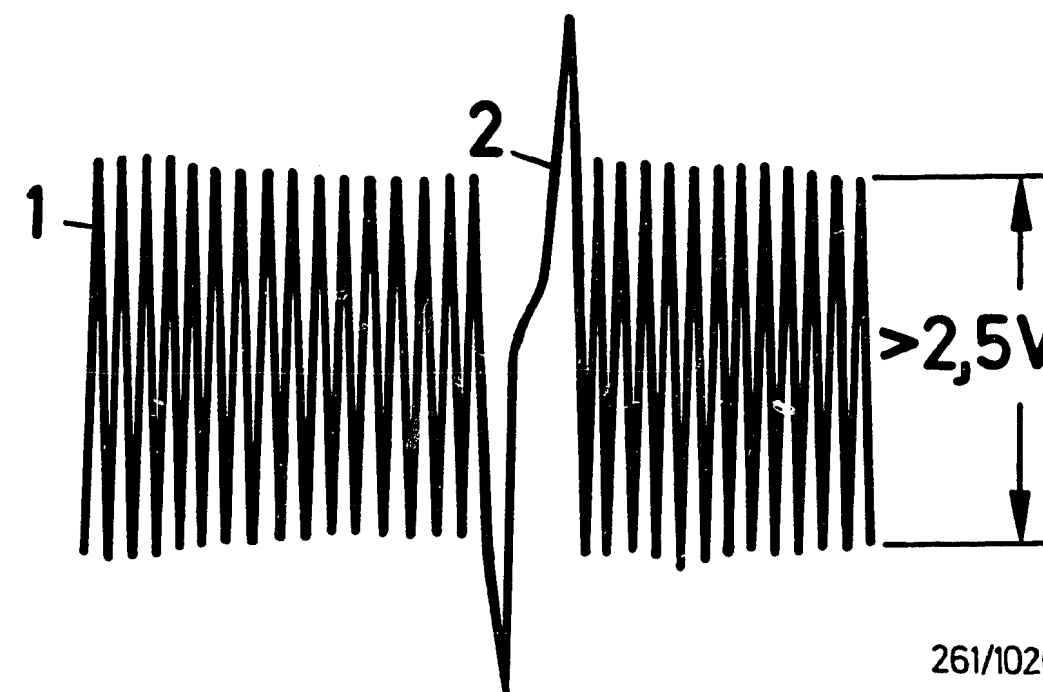
Engine at operating temperature,
switch off loads.

- * Idle speed with
 - manual transmission 850 ± 60 min ⁻¹ +)
 - automatic transmission 750 ± 60 min ⁻¹ +)
- * Ignition angle: 10 ± 5 ° CS +)

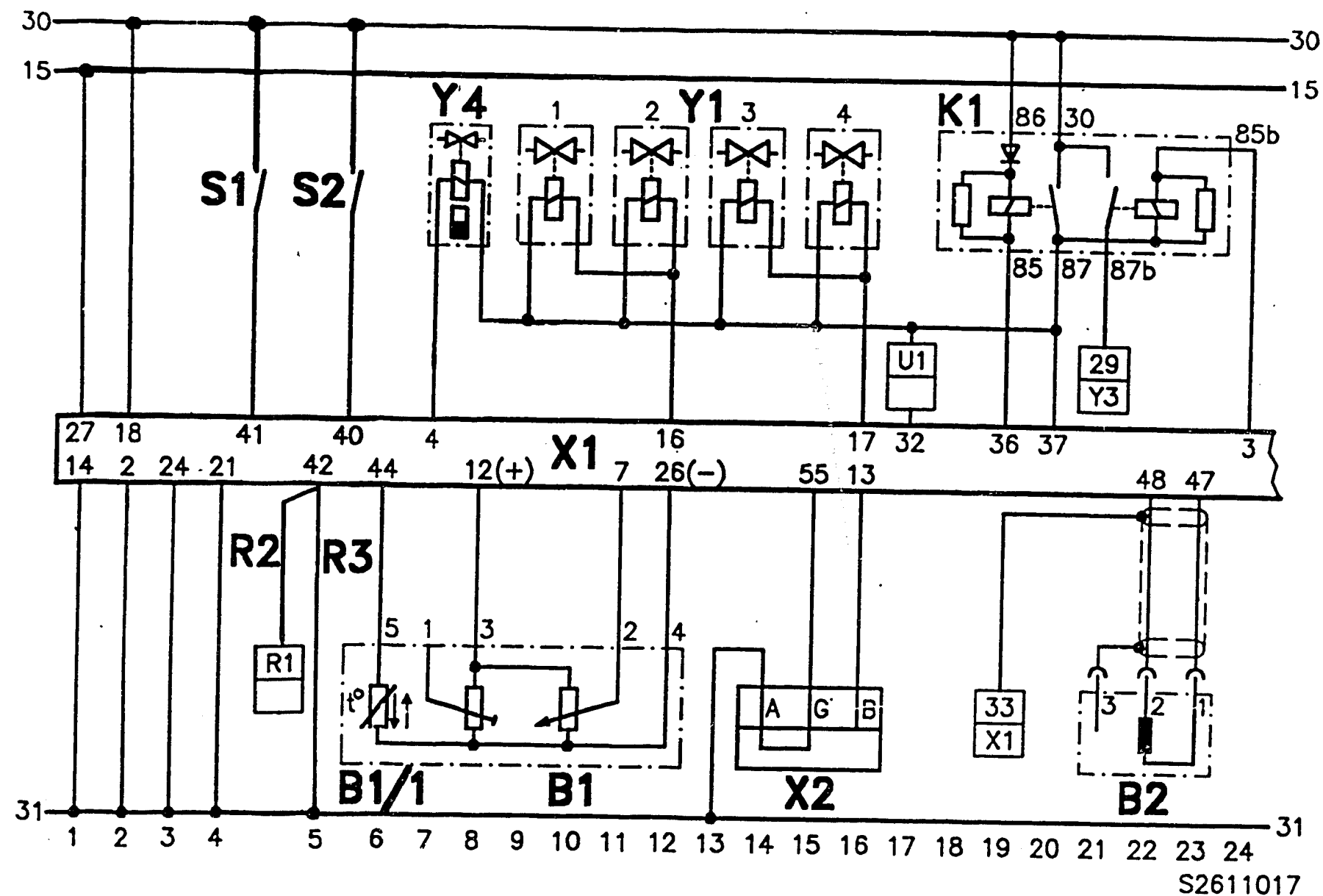
Automatic transmission on N or P

-
- +) Important!
The stated basic values may differ as a
result of variant encoding.
Pay attention to table in "Special Features"
section.

Refer to equipment and Autodata microcard for
settings as regards valve clearance and other
engine-related data.



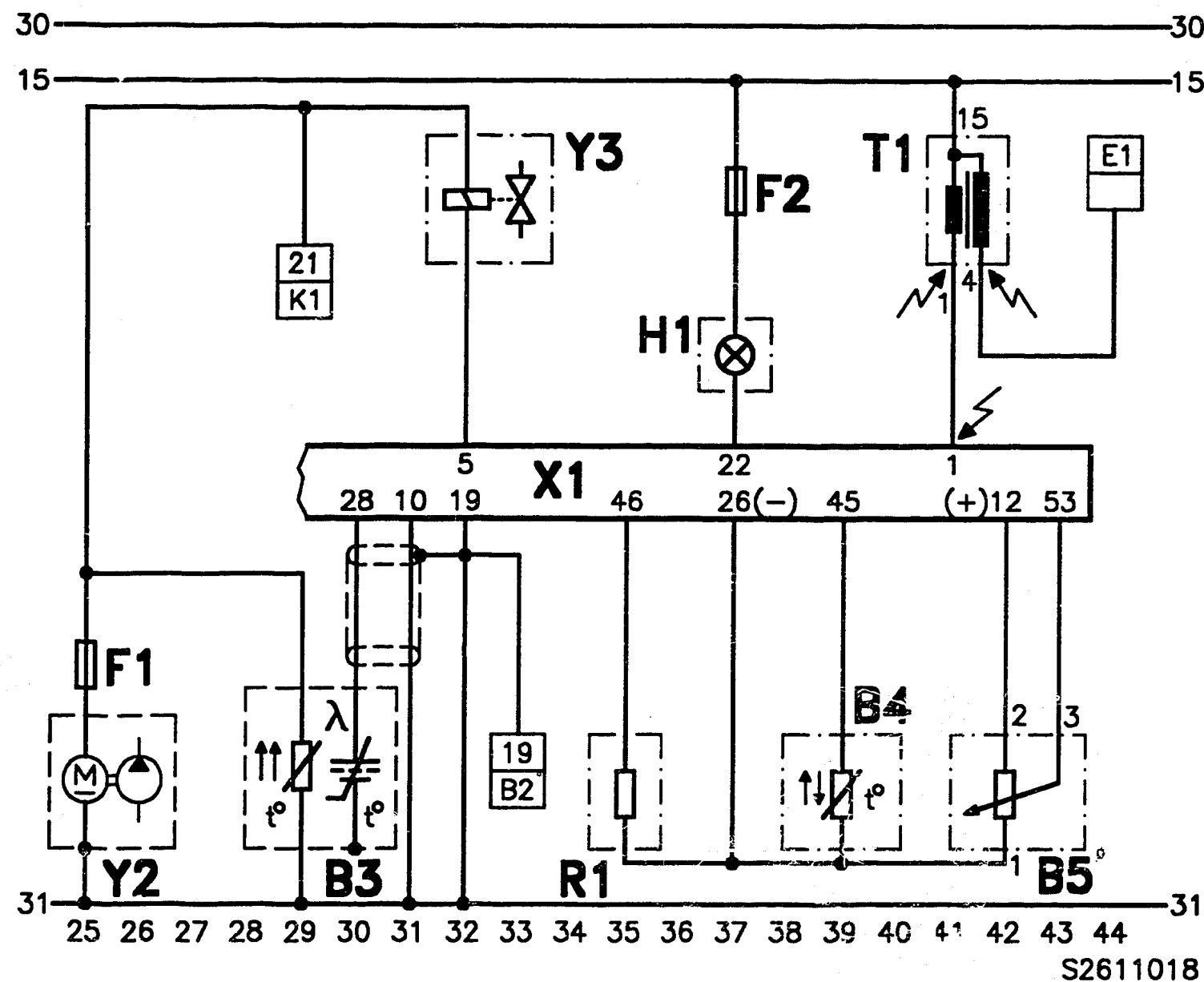
Pulse pattern of engine-speed/reference-mark sensor
1 = Engine-speed signal
2 = Reference-mark signal



ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
 B1/1 = Temperature sensor, air
 B2 = Engine-speed/reference-mark sensor
 K1 = Motronic relay
 R1 = Refer to variant encoding
 R2 = Only for automatic transmission
 R3 = Only for manual transmission

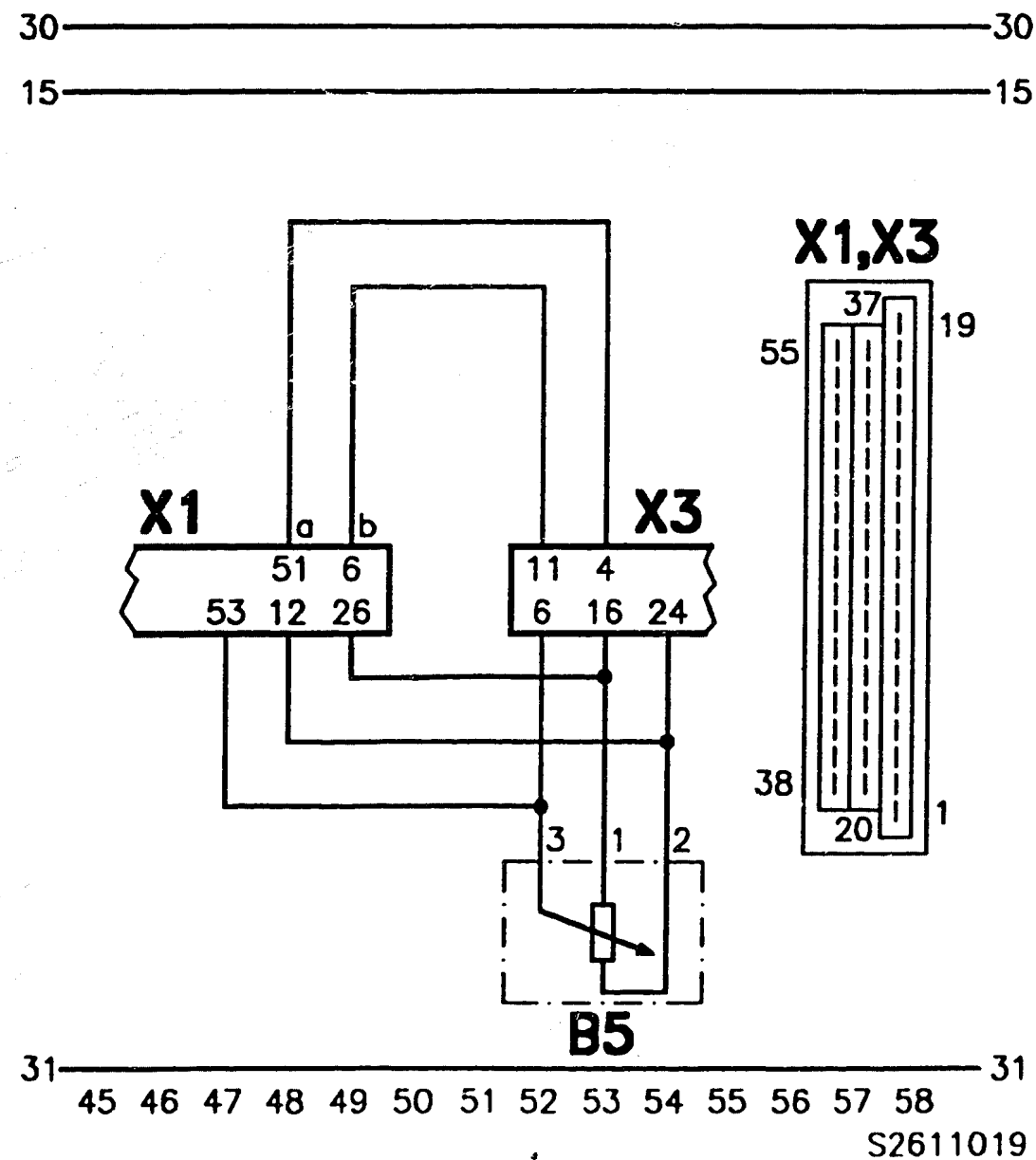
S1 = A/C readiness switch
 (if A/C provided)
 S2 = A/C compressor switch
 (if A/C provided)
 U1 = Vehicle computer
 X1 = Motronic control-unit plug
 X2 = Diagnosis plug
 Y1 = Solenoid-operated inj. valves
 Y4 = Idle actuator



ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

B2 = Engine-speed/reference-mark sensor
 B3 = Heated lambda sensor
 B4 = Temperature sensor (coolant)
 B5 = Throttle-valve sensor
 E1 = H.T. distributor
 F1 = Pump fuse (20 A)
 F2 = Fuse (20A)

H1 = Fault lamp
 K1 = Motronic relay
 R1 = Refer to variant encoding
 T1 = Ignition coil
 X1 = Motronic control-unit plug
 Y2 = Electric fuel pump
 Y3 = Tank ventilation valve

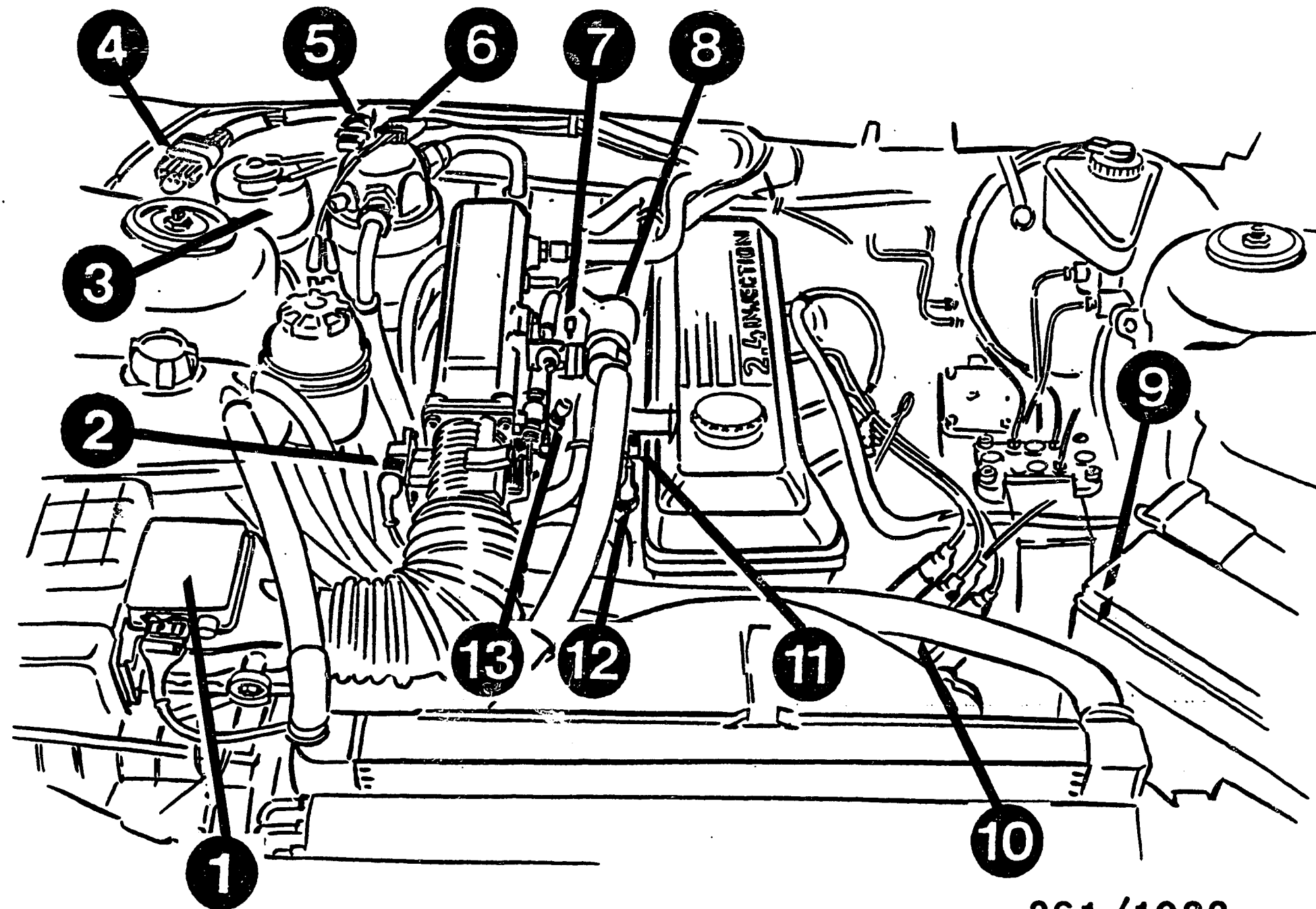


ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

(Deviation for vehicles with electronic transmission control)

B5 = Throttle-valve sensor
X1 = Motronic control-unit plug
X3 = Transmission control-unit plug
from Bosch

a = Input for engine intervention
b = Engine-speed information for transmission control

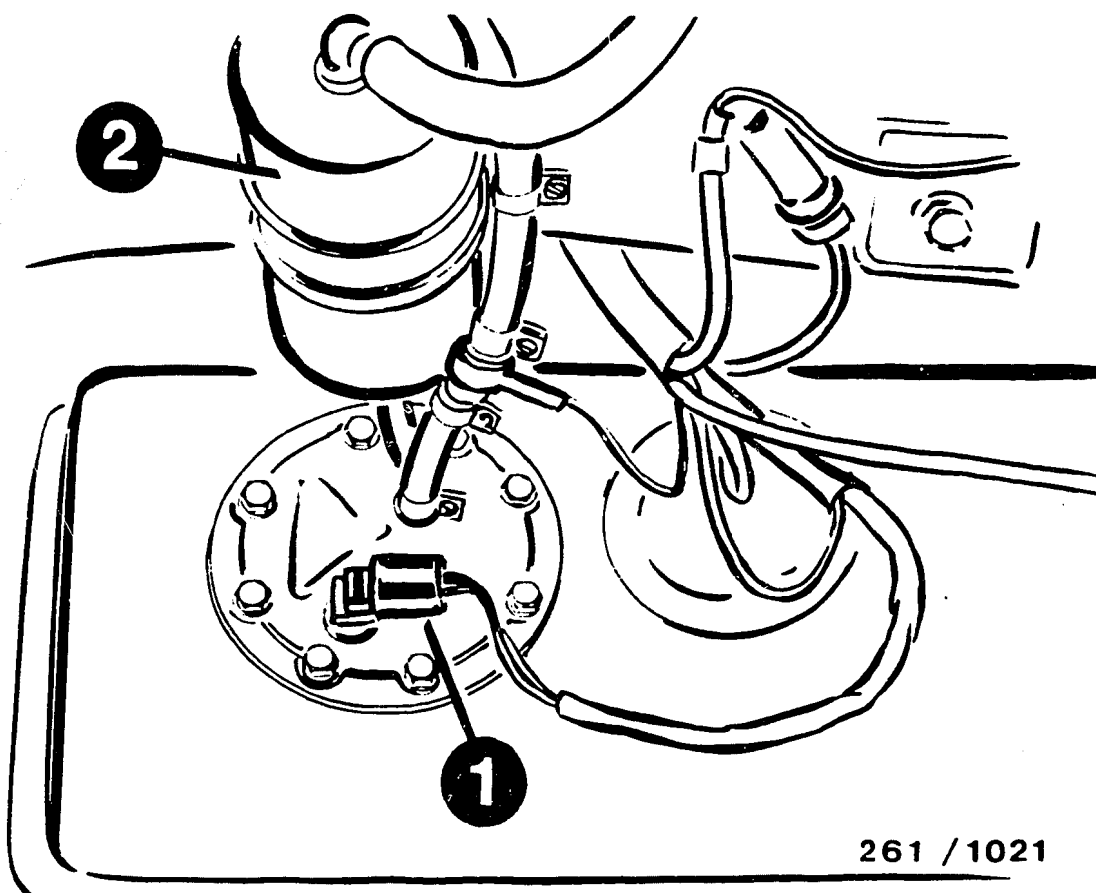


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INSTALLATION POSITION OF COMPONENTS

- 1 = Air-flow sensor
- 2 = Throttle-valve sensor
- 3 = Active-carbon container
- 4 = Diagnosis plug
- 5 = Octane-number encoding plug
- 6 = Lambda-sensor plug connection

- 7 = Injection valves
- 8 = Idle actuator
- 9 = Ignition coil
- 10 = Ignition distributor
- 11 = Tank ventilation valve
- 12 = Temperature sensor (coolant)
- 13 = Vent valve



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- 1 = Plug for in-tank pump
2 = Fuel filter

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The installation locations always refer to the direction of travel.

- * Electric fuel pump and fuel filter:
Up to 09.88: in front of fuel tank.
As of 09.88 (with the exception of Kombi vehicles):
In-tank pump. Filter in front of fuel tank.
Notes: Empty tank before removing pump.
CAUTION: Danger of fire!
If possible, use fitted pump for emptying.
Pay attention to polarity of pump.
Use new cover seal.
- * Control unit:
On right in passenger's footwell.
Raise rubber strip and cover at door sill somewhat.
Move carpeting aside and remove control-unit cover.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Pressure gauge installation:
Decrease fuel pressure by way of vent valve.
Catch fuel with rag. Install pressure gauge in fuel-injection tubing (M 16x1.5).
Actuate vent valve before and after intervention in fuel system.
Watch out for leaks!
- * Fuel pressure regulator:
Beneath idle actuator.
- * Reference-mark/engine-speed sensor:
At oil pump housing next to oil filter (accessible from underneath).
- * Ground terminals:
At intake manifold, rear.
- * Motronic relay:
In E-box located between bulkhead and spring-strut dome.
- * Lambda sensor:
In joint exhaust pipe in engine compartment.
- * Fuses:
In instrument panel, bottom left.
Underside of fuse box can be swung out.
- * Temperature sensor (air):
In air-flow sensor.
- * Ignition-distributor adjustment:
Remove cap and protective cover from ignition distributor.
Set cylinder 1 to ignition timing mark (pointer in inspection port on cylinder block faces ball in flywheel).
Center of ignition-distributor rotor must point towards housing mark, cylinder 1.
If necessary, turn ignition-distributor housing; loosen clamping flange to do so.

Trouble-shooting instructions : BEY-5000
BOSCH system : EI
Make of vehicle : BENTLEY
Basic microcard : KFZ-00..

TABLE OF CONTENTS

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Bentley model:

Mulsanne Turbo with 6.75 l/ 8-cyl. V-engine
Model EU 9. 86 ->

Electronic ignition system with load detection by means of intake-manifold-pressure measurement (EI).

- * Control unit 0 227 400 036
- * Trigger box 0 227 100 124 (with current limitation).
- * Ignition coil 0 221 118 383
- * Cylinder arrangement of 8 cyl. V-engine

Right-hand cylinder bank is designated A 1 - A 4.
Left-hand cylinder bank is designated B 1 - B 4.
Cyl. 1 is thus front right in the direction of travel.

- * Engine firing sequence:

A1 - A3 - B3 - A2 - B2 - B1 - A4 - B4

The EI system installed in this vehicle corresponds to the system used in the Porsche 928 S with the following differences:

- * No map switching.
- * KE-Jetronic fuel-injection system instead of LH-Jetronic.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

For production reasons:
continued on the following
coordinate.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on.
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

						Cause (component fault)
*	*	*	*	*	*	High-tension side
*	*	*	*	*		Ignition coil
*	*					Firing sequence
*						Voltage, EI-control unit
*						Voltage, trigger box
*						Voltage, primary circuit
*		*	*			Engine speed/reference mark sensor Internal resistance
*		*	*			Engine speed/reference mark sensor Insulation
*		*	*			Engine speed/reference mark sensor Voltage signal
*						Actuation, trigger box
*						Actuation, KE-Jetronic
*						Contact resistances
*						Primary signal
*						High-tension distributor

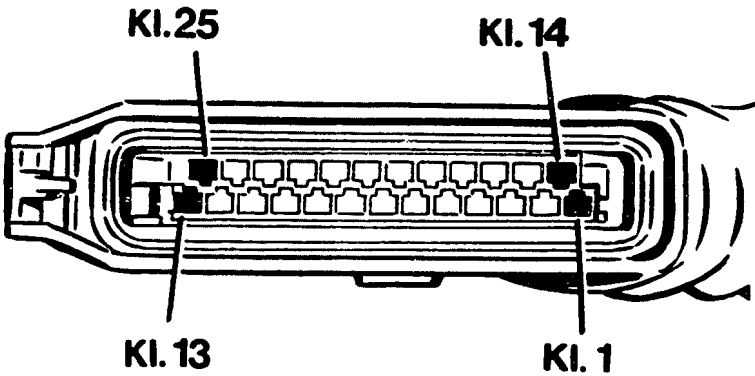
Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

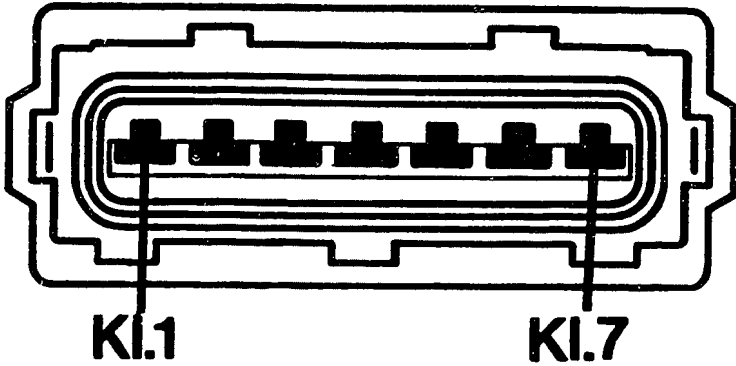
										Cause (component fault)
		*	*	*	*	*		*	*	Temperature sensor (coolant)
		*	*	*	*	*		*	*	Throttle-valve switch (idle)
		*	*	*	*	*		*	*	Throttle-valve switch (full load)
		*	*		*	*		*	*	Ignition point
			*			*		*	*	Vacuum sensor
			*							Voltage, EI-control unit with engine idling
			*							Voltage, trigger box with engine idling
			*							Voltage, ignition coil with engine idling
			*							Primary voltage (engine idling)

RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
1	HIGH-TENSION SIDE Check function for example of spark plugs, ignition harness and distributor cap (e.g. open circuit, short). Assess for example by way of ignition oscillogram, resistance measurement, visual inspection.	—	—
2	IGNITION COIL Visual inspection: plug present, sealing compound oozed out? Resistance, primary Resistance, secondary Perform measurement at both ignition coils.	1 15 1 4	0,4...0,7 Ω 4,9...8,7 k Ω
3	VOLTAGE, EI-CONTROL UNIT PLUG Detach control-unit plug. Voltage, control-unit plug. See top picture. Ignition ON.	25 10 (+) (-)	Battery voltage
4	VOLTAGE, TRIGGER BOX Detach trigger-box plug. Voltage, trigger-box plug. See bottom picture. Ignition ON. Measurement at both trigger-box plugs.	4 2 (+) (-)	Battery voltage
5	VOLTAGE, PRIMARY CIRCUIT Voltage, trigger-box plug. Ignition ON. Measurement at both trigger-box plugs.	1 2 (+) (-)	Battery voltage



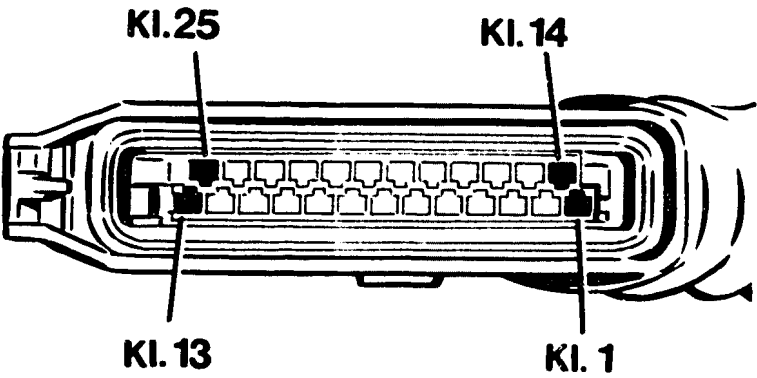
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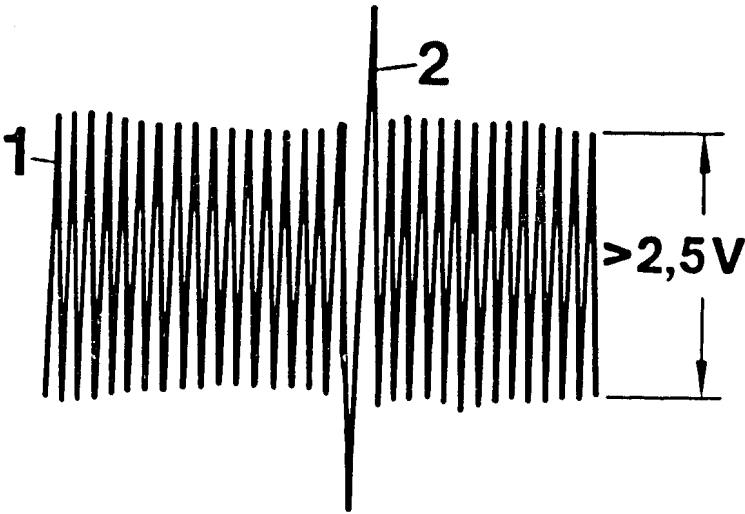
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RAPID DIAGNOSIS CHART (CONTINUED)

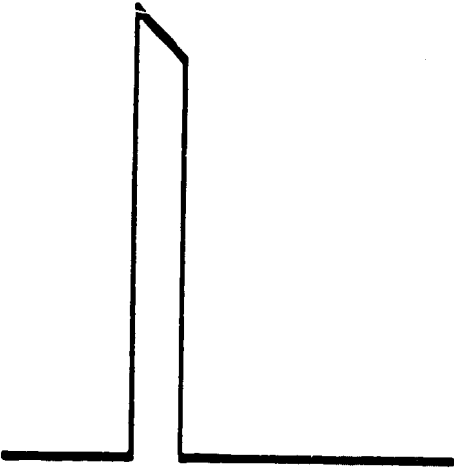
Test steps	Testing of component/function Test instructions/conditions	Terminals	Set values
6	ENGINE-SPEED/REFERENCE-MARK SENSOR Ignition OFF. EI-control unit plug detached. Resistance, EI-control unit plug. See top picture.	7 19	0,6...1,6 k Ω
7	INSULATION, ENGINE-SPEED/REFERENCE-MARK SENSOR EI-control unit plug detached. Resistance, EI-control unit plug.	7 20	> 1 M Ω
8	VOLTAGE, ENGINE-SPEED/REFERENCE-MARK SENSOR EI-control unit plug detached. Oscilloscope "special" to EI-control unit plug Actuate starting motor. See center picture. 1 = Engine speed signal 2 = Reference-mark-sensor signal	7 19 (+) (-)	Engine speed signal > 2.5 V
9	ACTUATION, TRIGGER BOX Ignition OFF. Attach EI-control unit plug. Oscilloscope "special" to trigger-box plug. Actuate starting motor. See bottom picture. Perform measurement at both trigger boxes.	5 2 (+) (-)	Control signal



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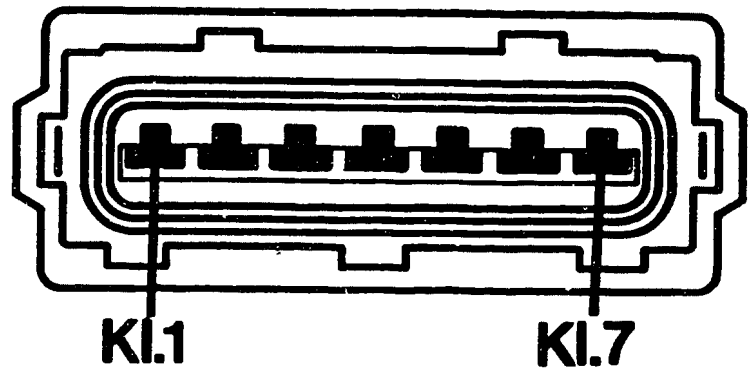
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RAPID DIAGNOSIS CHART (CONTINUED)

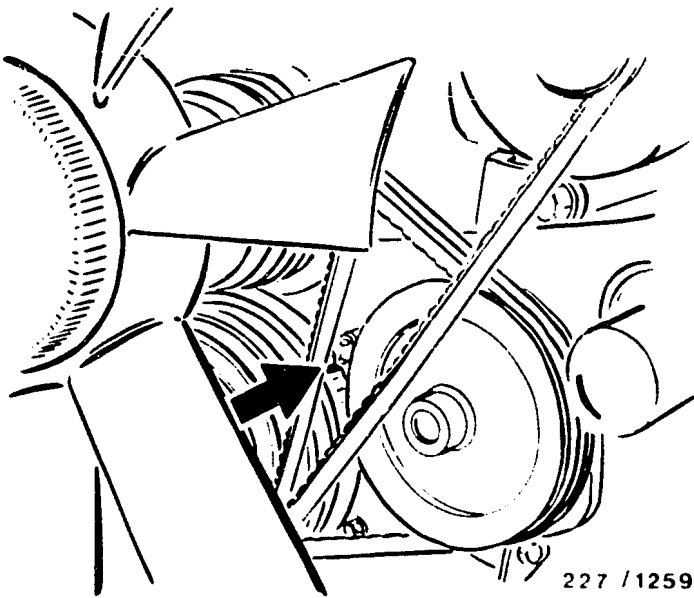
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
10	ACTUATION, KE-JETRONIC CONTROL UNIT Ignition OFF. Detach KE-Jetronic control-unit plug. Oscilloscope "special" to KE-Jetronic control-unit plug. Actuate starting motor. Attach KE-Jetronic control-unit plug.	25 B- (+) (-)	Rectangular pulse
11	CONTACT RESISTANCES (primary side) Subsequent test must be performed at both trigger-box plugs. See picture. Detach negative and positive lead from battery. Ignition ON. Resistance between battery terminal and trigger-box plug. Resistance between batt. term. and ign. coil. Resistance between trig.-box plug and ign.coil.	B+ 4 B- 2 B+ 15 1 1	max. 0.3 Ω max. 0.3 Ω
12	PRIMARY SIGNAL Attach trigger-box plug. Oscilloscope/engine-speed tester to ignition coil. Actuate starting motor. Perform measurement at both ignition coils.	15 1 (+) (-)	Primary voltage/ engine speed reading (magnitude irrelevant)



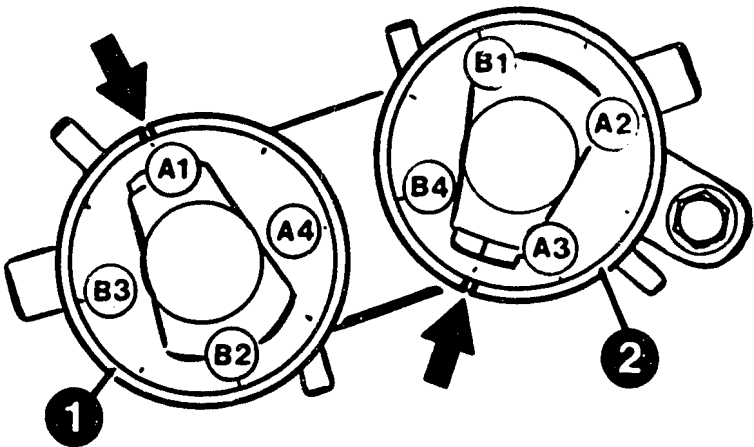
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RAPID DIAGNOSIS CHART (CONTINUED)

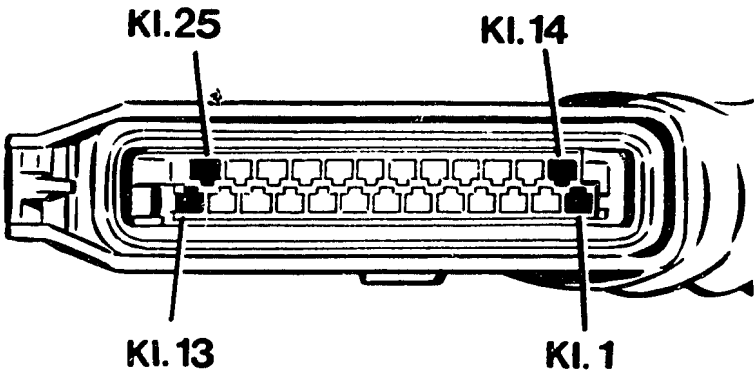
Test step	Testing of component/function Test instructions/conditions	Terminals	Set values															
13	<p>HIGH-TENSION DISTRIBUTOR</p> <p>Basic setting: Set engine cyl. 1 in compression stroke to 42° BTDC. Distributor rotors of high-tension distributors 1 and 2 point to housing marks.</p> <p>Ignition-cable arrangement:</p> <p>High-tension distributor 1 term. 4 is connected to ignition coil/trigger box group 1. High-tension distributor 2 term. 4 is connected to ignition coil/trigger box group 2.</p>		<p>See top picture. (e.g. TDC mark)</p> <p>See center picture. (arrow)</p> <p>See center picture.</p>															
14	<p>TEMPERATURE SENSOR (COOLANT)</p> <p>Ignition OFF. Detach EI-control unit plug. Resistance, EI-control unit plug. See bottom picture.</p> <table><tr><td>Temperature:</td><td>+ 20°C</td><td>2,1...2,9 k Ω</td></tr><tr><td></td><td>+ 30°C</td><td>1,4...2,0 k Ω</td></tr><tr><td></td><td>+ 80°C</td><td>280...370 Ω</td></tr><tr><td></td><td>+ 90°C</td><td>210...280 Ω</td></tr><tr><td></td><td>+ 100°C</td><td>160...210 Ω</td></tr></table>	Temperature:	+ 20°C	2,1...2,9 k Ω		+ 30°C	1,4...2,0 k Ω		+ 80°C	280...370 Ω		+ 90°C	210...280 Ω		+ 100°C	160...210 Ω	23 10	
Temperature:	+ 20°C	2,1...2,9 k Ω																
	+ 30°C	1,4...2,0 k Ω																
	+ 80°C	280...370 Ω																
	+ 90°C	210...280 Ω																
	+ 100°C	160...210 Ω																



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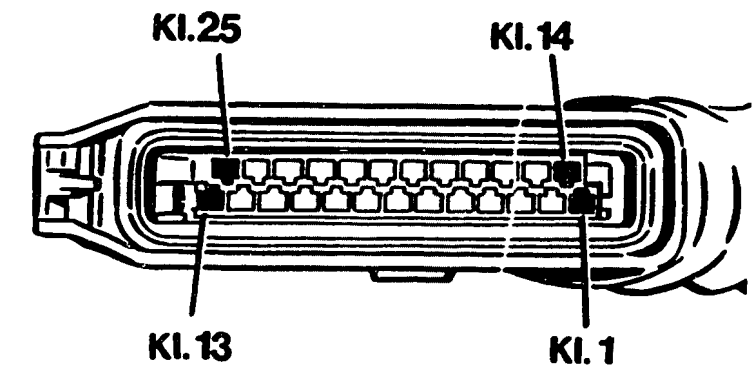
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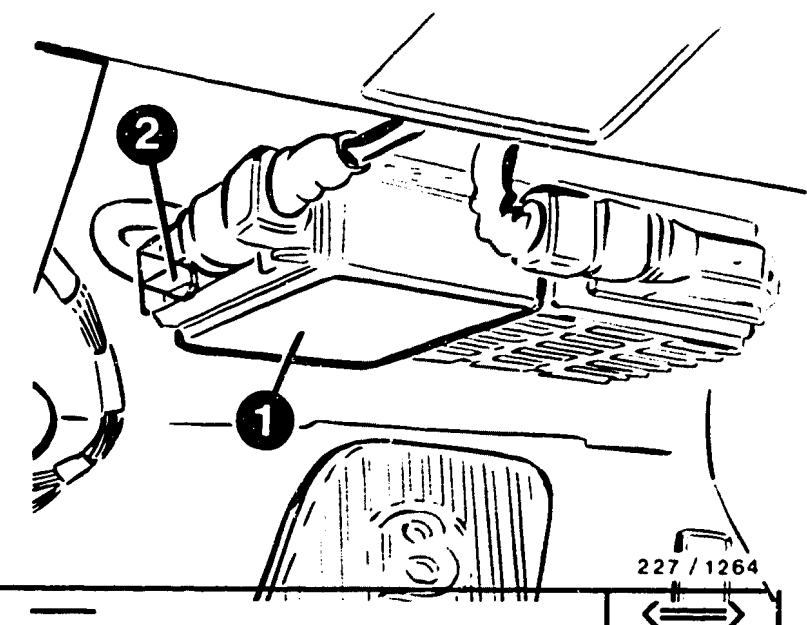
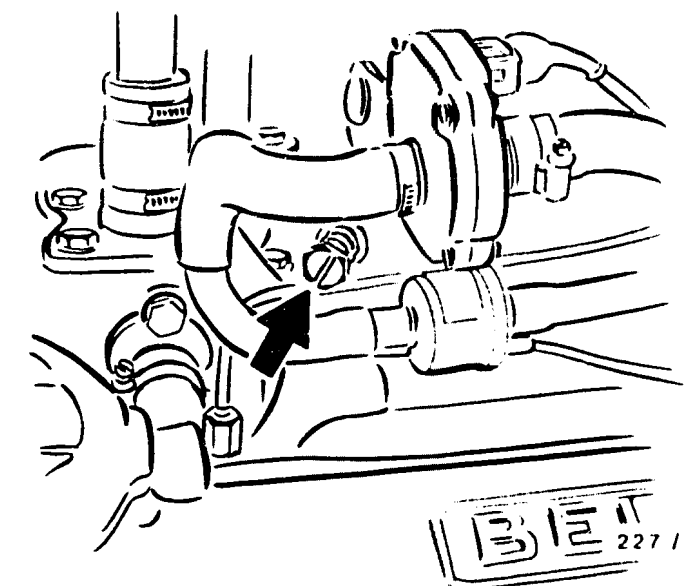
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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
15	THROTTLE-VALVE SWITCH (IDLE CONTACT) Detach control-unit plug, KE-Jetronic. Throttle valve closed. Resistance, EI-control unit plug. See top picture.	4 10	0...10 Ω
16	THROTTLE-VALVE SWITCH (FULL-LOAD CONTACT) Detach control-unit plug, KE-Jetronic. Throttle valve open. Resistance, EI-control unit plug. See top picture.	17 10	0...10 Ω
17	IGNITION POINT Adjust engine speed with idle adjusting screw. See center picture (arrow). Determine ignition angle.		7° BTDC at 570...590 min ⁻¹
18	VACUUM SENSOR EI-control unit plug and trigger-box plug. Engine idling (operating temperature). Detach plug from throttle-valve switch. Read off idle speed. Detach vacuum hose (2) from control unit (1) and seal. See bottom picture. Read off idle speed.		There must be a change in idle speed.

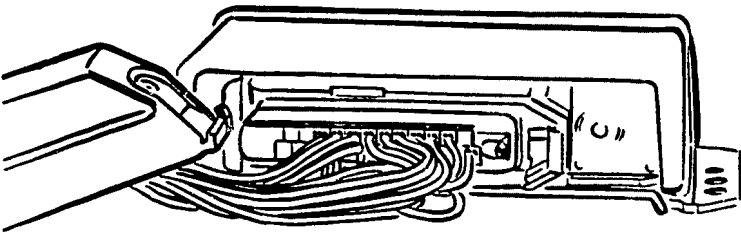


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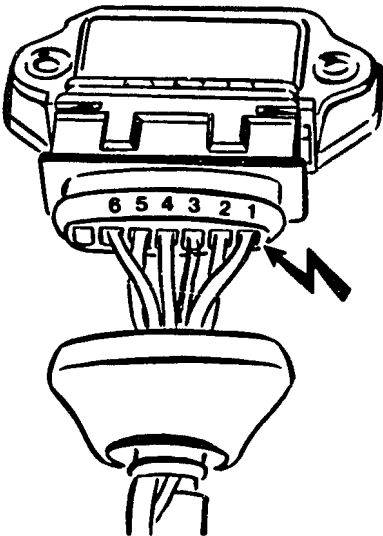


RAPID DIAGNOSIS CHART (CONTINUED)

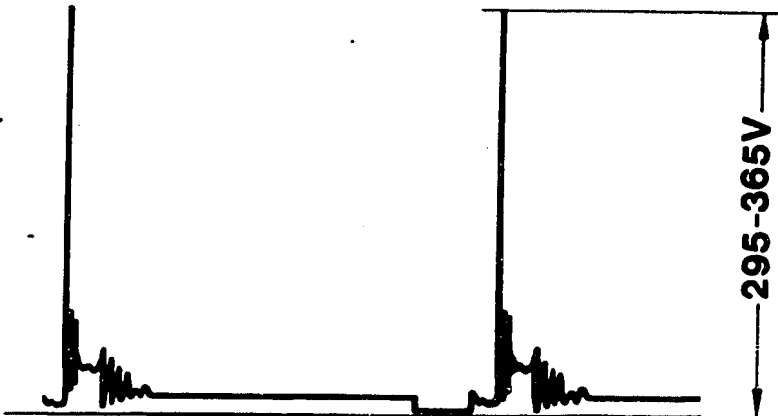
Test steps	Testing of component/function Test instructions/conditions	Terminals	Set values
19	VOLTAGE, EI-CONTROL UNIT Remove handle cover from EI-control unit plug Voltage, EI-control unit plug. See top picture. Engine idling.	25 10 (+) (-)	12...14 V, max. 1 V below U _B
20	VOLTAGE, TRIGGER BOX Push back rubber sleeve at trigger-box plug. Voltage at trigger box. See center picture. Engine idling. Perform measurement at both trigger boxes.	4 2 (+) (-)	12...14 V, max. 1 V below U _B
21	VOLTAGE, IGNITION COIL Voltage, ignition coil and battery. Engine idling. Perform measurement at both ignition coils.	15 B- (+) (-)	Equal to /greater than 10 V
22	PRIMARY VOLTAGE Oscilloscope with pulse-shaping circuit to ignition coil. Engine idling. See bottom picture. Perform measurement at both ignition coils.	15 1 (+) (-)	295...365 V



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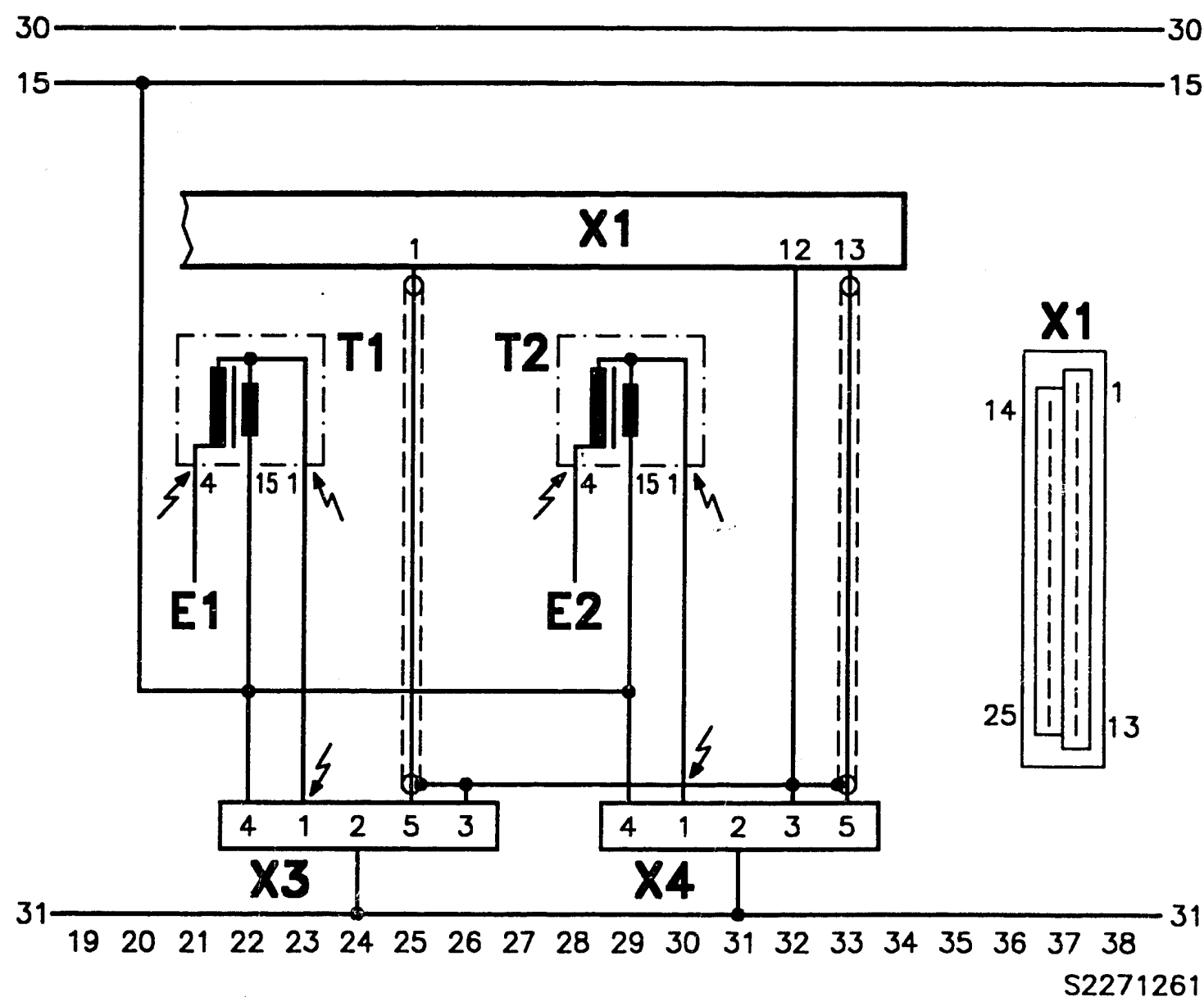
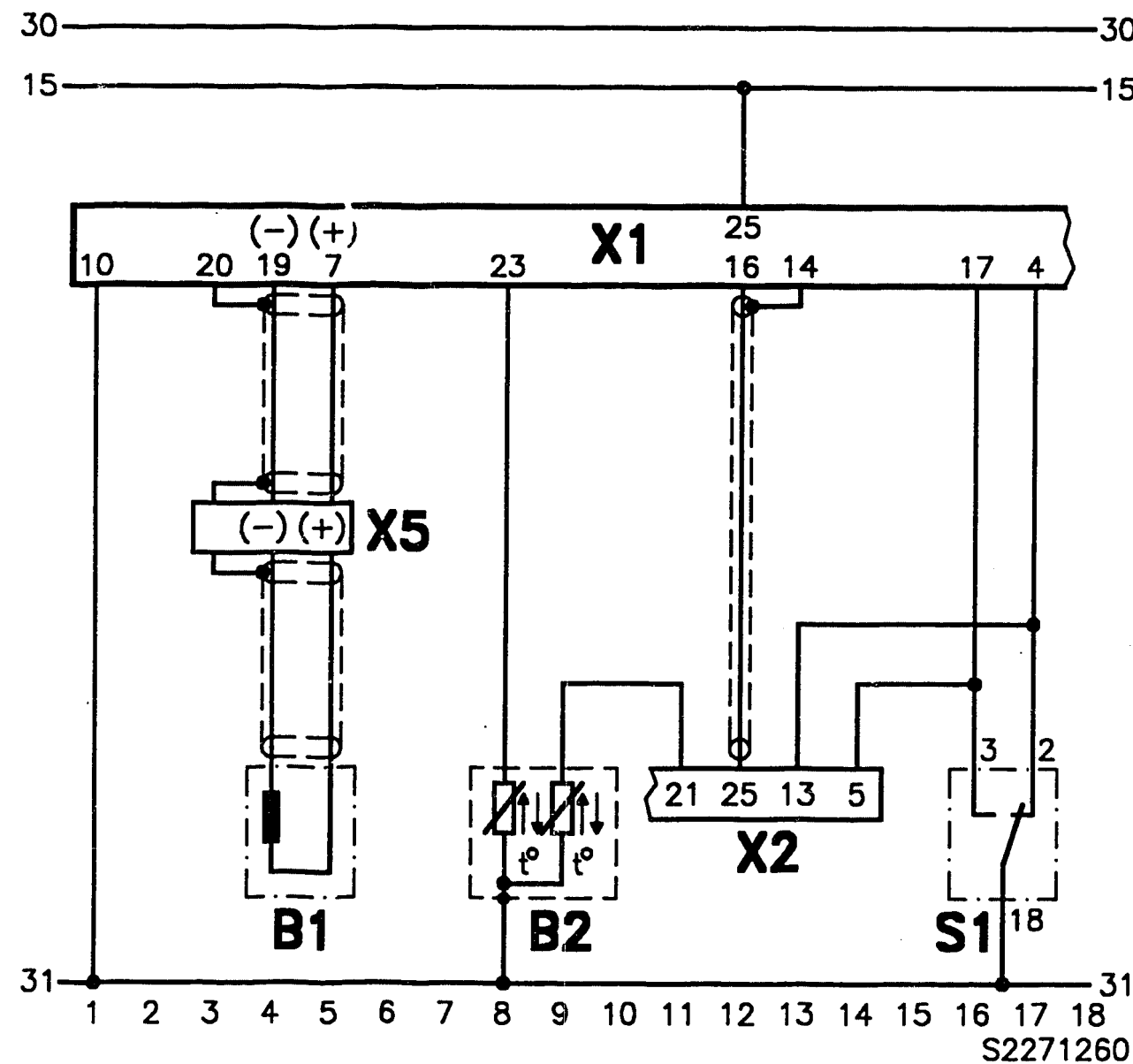


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TEST SPECIFICATIONS

Ignition coil, primary	0,4...0,7 Ω										
Ignition coil, secondary	4,9...8,7 k Ω										
Temperature sensor (coolant)											
Note: twin NTC											
Resistance at coolant temperature	<table> <tr> <td>+ 20° C</td><td>2,1...2,9 k Ω</td></tr> <tr> <td>+ 30° C</td><td>1,4...2,0 k Ω</td></tr> <tr> <td>+ 80° C</td><td>280...370 Ω</td></tr> <tr> <td>+ 90° C</td><td>210...280 Ω</td></tr> <tr> <td>+100° C</td><td>160...210 Ω</td></tr> </table>	+ 20° C	2,1...2,9 k Ω	+ 30° C	1,4...2,0 k Ω	+ 80° C	280...370 Ω	+ 90° C	210...280 Ω	+100° C	160...210 Ω
+ 20° C	2,1...2,9 k Ω										
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+ 80° C	280...370 Ω										
+ 90° C	210...280 Ω										
+100° C	160...210 Ω										
Ignition point at	7 ° BTDC 570...590 min ⁻¹										
Voltage, EI-control unit with engine idling	12...14 V										
Voltage, ignition coils with engine idling	equal to/ greater than 10 V										
Primary voltage with engine idling	295...365 V										
Engine-speed/reference mark sensor											
Air gap	0,5...1,5 mm										
Insulation	> 1 M Ω										
Internal resistance	0,6...1,6 k Ω										
Voltage (engine speed signal)	U _{pp} > 2,5 V										
Voltage, trigger box with engine idling	12...14 V										
Refer to Autodata test specifications for settings as regards exhaust gas, idle speed etc.											

For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: Caution, 400 V...25 kV

B1 = Engine-speed/reference-mark sensor

B2 = Temperature sensor (coolant)

E1 = to high-tension distributor 1

E2 = to high-tension distributor 2

S1 = Throttle-valve switch

T1 = Ignition coil cyl. A1-B3-B2-A4

T2 = Ignition coil cyl. B1-B4-A3-A2

X1 = EI-control unit

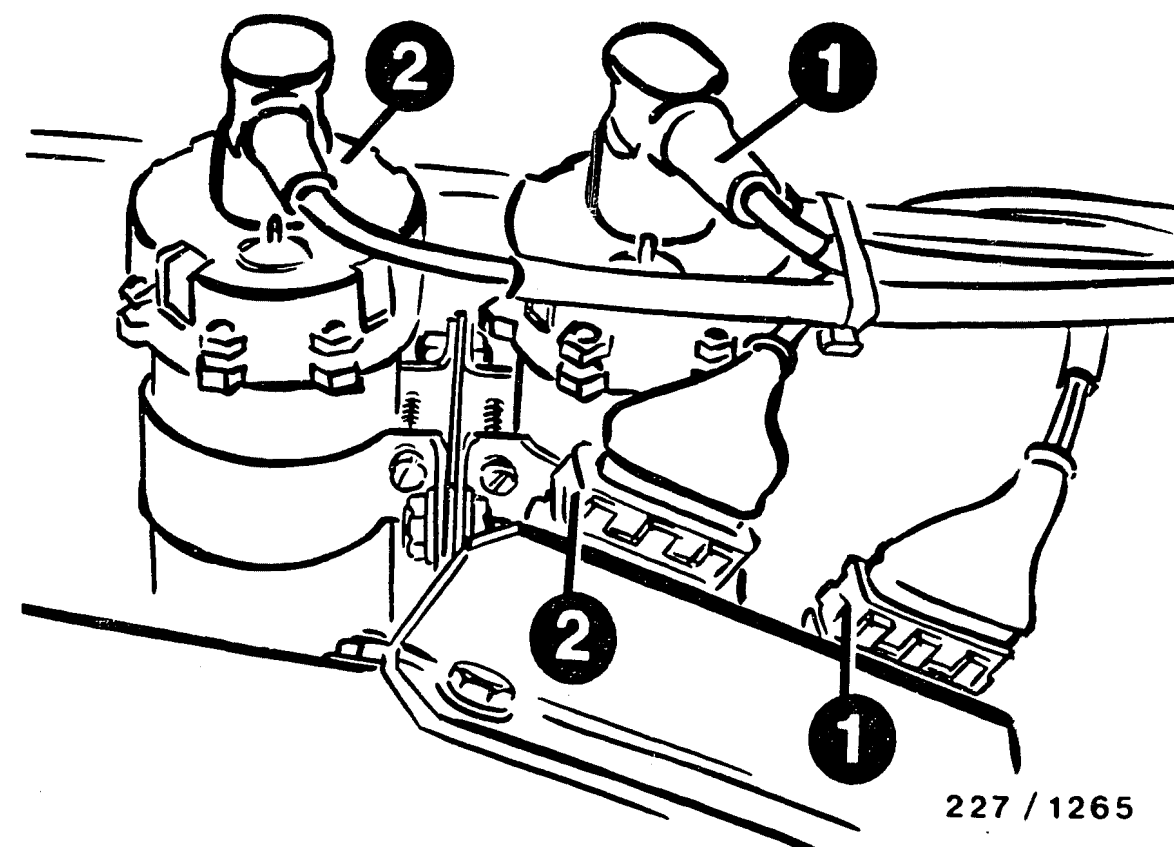
X2 = KE-Jetronic control unit

X3 = Trigger box, ignition 1

X4 = Trigger box, ignition 2

X5 = Plug connection,
engine-speed/
reference-mark
sensor

For production reasons:
continued on the following
coordinate.



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INSTALLATION POSITION OF COMPONENTS

Ignition coils and trigger boxes are located
in engine compartment on right behind windscreen
washer reservoir.

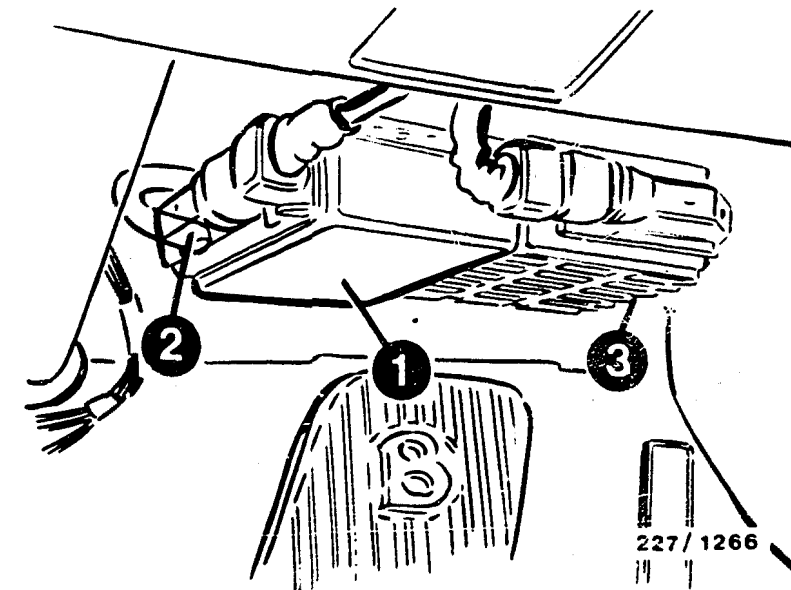
Group 1:
Ignition coil/trigger box for cyl. A1-B3-B2-A4

Group 2:
Ignition coil/trigger box for cyl. B1-B4-A3-A2

INSTALLATION POSITION OF COMPONENTS (continued)

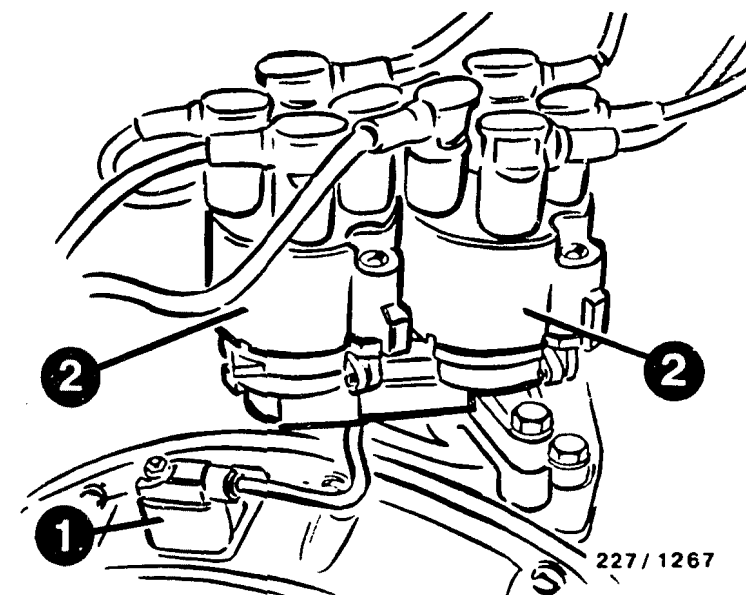
The EI-control unit (1) is located in the passenger compartment on the right beneath the instrument panel.

- 1 = EI-control unit
- 2 = Vacuum connection to EI-control unit for vacuum sensor.
- 3 = KE-Jetronic control unit



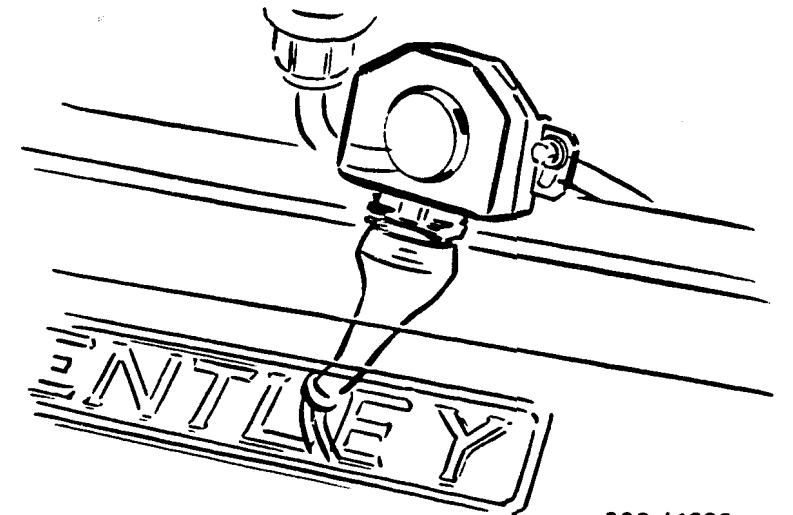
Engine-speed/reference-mark sensor (1) is mounted on transmission bell housing in vicinity of high-tension distributor.

The high-tension distributors (2) have a joint housing and can only be replaced as a complete unit.
(Bentley service part)



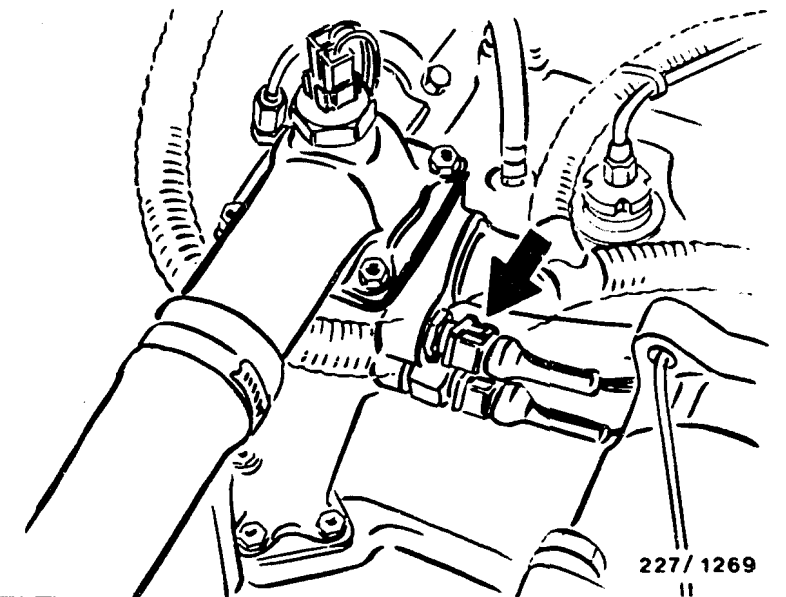
INSTALLATION POSITION OF COMPONENTS (continued)

The throttle-valve switch is located at the throttle-valve section beneath the intake manifold.



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The temperature sensor (engine) is screwed into the thermostat housing.
See picture (arrow)



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Trouble-shooting instructions : OPE-5022
BOSCH system : EI
Make of vehicle : OPEL
Basic microcard : KFZ-00..

TABLE OF CONTENTS

Section	Coordinate
Special features, usage, safety.....	02
Trouble-shooting chart.....	07
Rapid diagnosis chart.....	09
Test specifications.....	21
Electrical terminal diagram.....	23
Installation position of components, removal and installation instructions.....	25

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Opel model:

Rekord-E with 2.2 l/ 4-cyl.engine 22 E
11.84 ->.

- * Spark-advance unit 0 227 921 006,..015
- * Trigger box 0 227 100 124
(with current limitation)
- * Ignition coil 1 227 020 009
- * Ignition coil with trigger box 0 221 600 005

* The following changes have been made with regard to the basic instructions:

1. Perform F a u l t e l i m i n a t i o n
for test step VOLTAGE (SUPPLY) MAGNETIC
PULSE GENERATOR as follows:

Ignition OFF.
Detach ignition-distributor plug.
Connect voltmeter to ignition-distributor plug
term. 4 (+) and term. 2 (-).
Ignition ON.
If voltage is less than 10 V, check lead
from ignition-distributor plug term. 4 to
spark-advance-unit plug term.4 for short
to ground.
Renew spark-advance unit if there was no
short to ground.
Renew magnetic pulse generator if voltage
equal to or greater than 10 V.
If voltage 0 V, then consecutively connect
ohmmeter to:

Ignition-distributor plug		Spark-advance-unit plug (detach)
Term. 4	and	term. 4
Term. 2	and	term. 2

SPECIAL FEATURES (CONTINUED)

Spark-advance-unit Trigger-box plug
plug (detach)

Term. 1 and term. 3
Term. 3 and term. 4

Set value: approx. 0 Ω (continuity) in each case.
Eliminate open circuit.
Renew spark-advance unit if there was no
open circuit.

2. Perform F a u l t e l i m i n a t i o n
for test step MAGNETIC-PULSE-GENERATOR FUNCTION
as follows:

Ignition OFF
Detach ignition-distributor and spark-advance-
unit plug.
1. Check lead from ignition-distributor plug term. 12
to spark-advance-unit plug term. 12 for
open circuit, short to ground or short to
positive.
Eliminate fault.
Attach spark-advance-unit plug.

2. Connect voltmeter to ignition-distributor
plug term. 12 (+) and vehicle ground (-).
N o t e :
Use voltmeter with internal resistance (R_i)
in excess of 50 k Ω (otherwise incorrect
measurement).
Ignition ON.
Set value: equal to/greater than 2 V.
Renew spark-advance unit if set value
not attained.

Renew magnetic pulse generator/ignition
distributor if items 1 and 2 O.K.

SPECIAL FEATURES (CONTINUED)

3. Perform f a u l t e l i m i n a t i o n
for test step SPARK-ADVANCE UNIT
(FUNCTION) as follows:

Ignition OFF.
Detach spark-advance-unit and trigger-box
plug.
Check lead from spark-advance-unit plug
term.13 to trigger-box plug term. 5 for
open circuit, short to ground or short
to positive.
Eliminate fault.

Renew spark-advance unit if no fault
present.

4. Perform t r o u b l e s h o o t i n g
for test step CONTROL LEAD, CHARACTERISTIC-
CURVE ACTUATION (continued) as follows:

Ignition OFF.
Remove spark-advance unit and detach plug.
Detach both plugs of idle-speed regulator
(idle-speed regulator is located above LE-
Jetronic control unit).
Connect voltmeter to spark-advance-unit
plug term. 3 (+) and term. 7 (-).
Ignition ON.
Set value: approx. battery voltage.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

						Cause (component fault)
*			*			High-tension side
*						Firing sequence
*			*			Ignition coil
*						Ignition-distributor as-installed setting
*						Voltage, trigger box
*						Voltage, primary circuit
*						Ignition-distributor plug and socket
*						Voltage, magnetic pulse generator
*						Magnetic-pulse-generator function
*						Spark-advance-unit function
*						Contact resistance (primary side)
*						Primary signal
*	*	*	*	*	*	Basic ignition setting
			*	*		Control lead, characteristic curve control
			*	*		Part-load switch
			*	*		Temperature switch (air)
			*	*		Temperature switch (oil)

TROUBLE-SHOOTING CHART (CONTINUED)

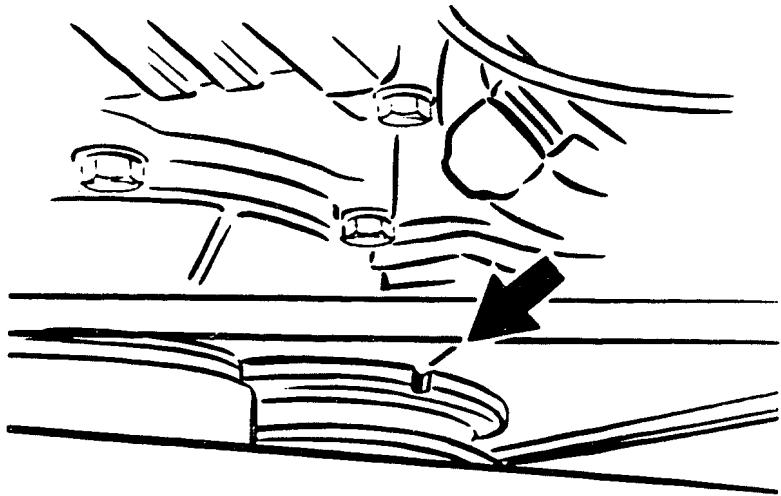
Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

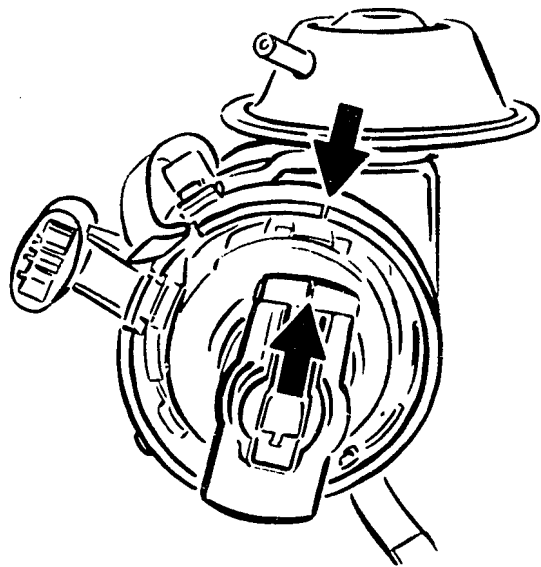
										Cause (component fault)
	*	*		*	*					Throttle-valve switch Idle/full load
			*							Voltage, trigger box (engine idling)
			*							Voltage, ignition coil (engine idling)
			*							Primary voltage (engine idling)

RAPID DIAGNOSIS CHART

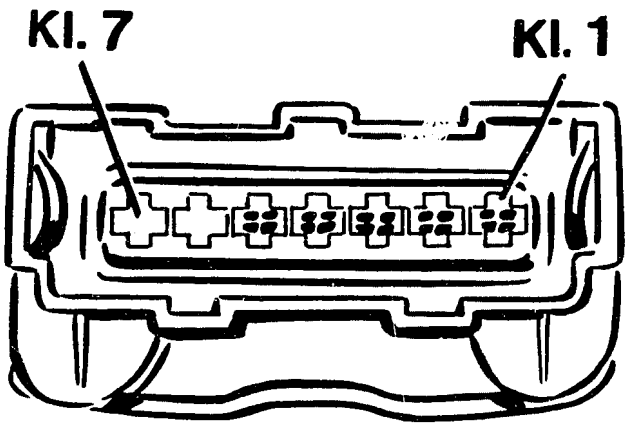
Test step	Testing of component/function Test instructions/conditions	Termin- als	Set values
1	HIGH-TENSION SIDE Test functioning of for example spark plugs, ignition harness and distributor cap (e.g. open-circuit, short). Assess for example by way of ignition oscillogram, resistance measurement, visual inspection.	—	—
2	IGNITION COIL Visual inspection: Plug present, sealing compound oozed out? Primary resistance Secondary resistance	1 15 1 4	0.6...1.0 Ω 6.4...11.1 k Ω
3	IGNITION-DISTRIBUTOR INSTALLATION SETTING Engine cyl. no. 1 on pulley mark (10° BTDC). See top picture, arrow. Center of distributor-rotor electrode points towards mark on housing. See center picture, arrow.	—	—
4	TRIGGER-BOX VOLTAGE Detach trigger-box plug. See bottom picture. Ignition ON. Trigger-box-plug voltage.	4 2 (+) (-)	Battery voltage
5	PRIMARY-CIRCUIT VOLTAGE Trigger-box plug detached. See bottom picture. Ignition ON. Trigger-box-plug voltage.	1 2 (+) (-)	Battery voltage



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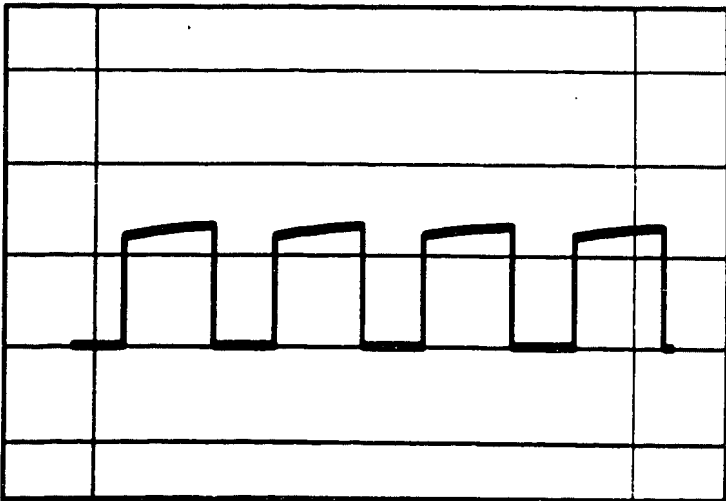
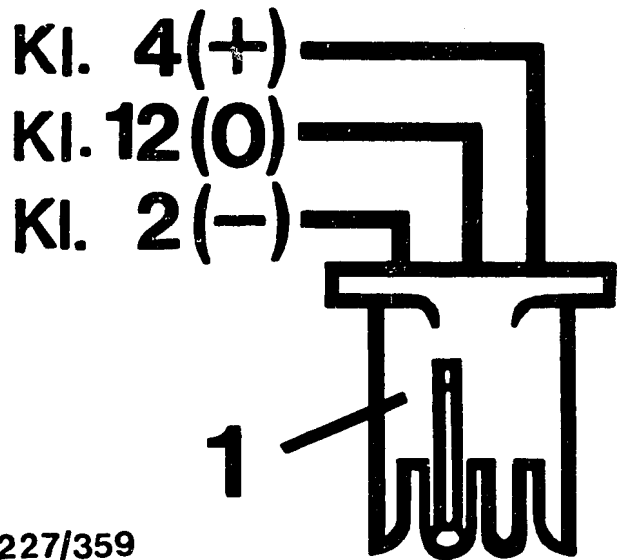
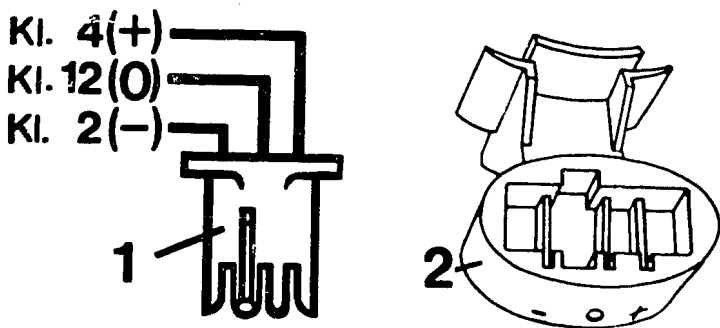
227 / 1316



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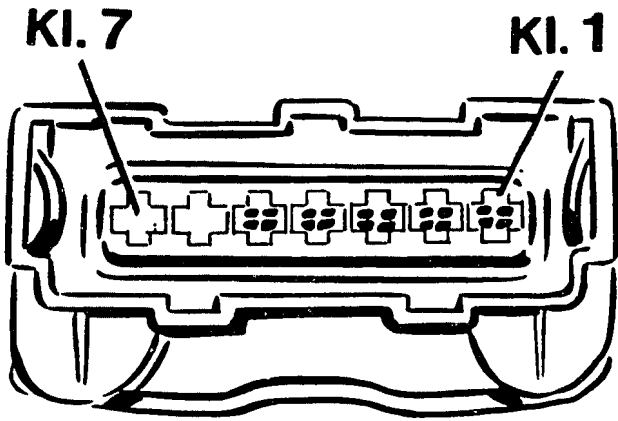
RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
6	IGNITION-DISTRIBUTOR PLUG AND SOCKET Detach ignition-distributor plug. Visual inspection: Check ignition-distributor plug and socket for oxidation. See top picture.	—	—
7	MAGNETIC-PULSE-GENERATOR VOLTAGE Attach ign.-distributor and trigger-box plug. Push back rubber sleeve of ignition-distributor plug. Ignition ON. Ignition-distributor-plug voltage. See center picture.	4 (+) 2 (-)	equal to/greater than 10 V
8	MAGNETIC-PULSE-GENERATOR FUNCTION Oscilloscope "special" to ignition-distributor plug and vehicle ground. See center picture. Start engine.	12 (+) B- (-)	Rectangular pulse (bottom picture)
9	IGNITION-ADVANCE-UNIT FUNCTION Push back rubber sleeve of trigger-box plug. Oscilloscope "special" to trigger-box plug and vehicle ground. Start engine.	5 (+) B- (-)	Rectangular pulse (bottom picture)

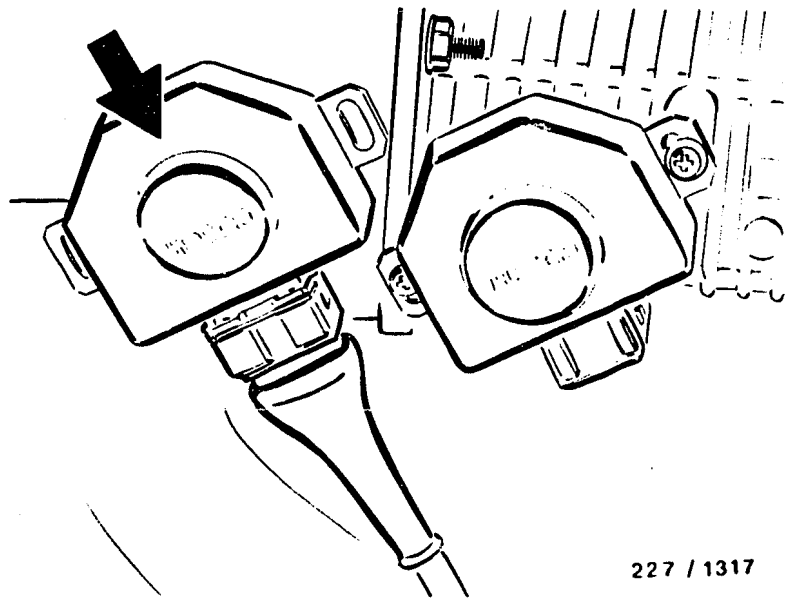


RAPID DIAGNOSIS CHART (CONTINUED)

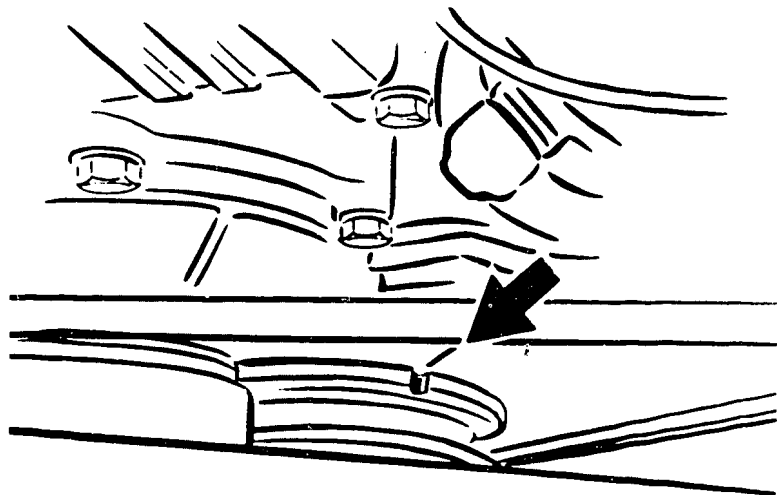
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
10	CONTACT RESISTANCE (PRIMARY SIDE) Detach negative and positive lead from battery. Detach trigger-box plug. See top picture. Ignition ON. Resistance between battery terminal and trigger-box plug. Resistance between battery term. and ign. coil. Resistance bet. ign. coil and trigger-box plug.	 B+ 4 B- 2 B+ 15 1 1	 max. 0.3 Ω max. 0.3 Ω
11	PRIMARY SIGNAL Connect negative and positive lead to battery. Attach trigger-box plug. Connect oscilloscope/engine-speed tester to ignition coil. Start engine.	 15 1 (+) (-)	 Primary voltage/ engine-speed indication (magni- tude irrelevant)
12	BASIC IGNITION SETTING Engine at operating temperature (oil temperature approx. +80°C). Ignition OFF. Connect Motortester in accordance with operating instructions. Detach plug from throttle-valve switch and attach shorting device KDZS 0003 to detached plug. See center picture, arrow. Detach ignition distributor vacuum hose. Run engine at 700...1000 min ⁻¹ . Read off ignition angle/aim lamp at ignition firing point marks (mark corresponds to 10° BTDC). See bottom picture.	 —	 10° ± 2° BTDC



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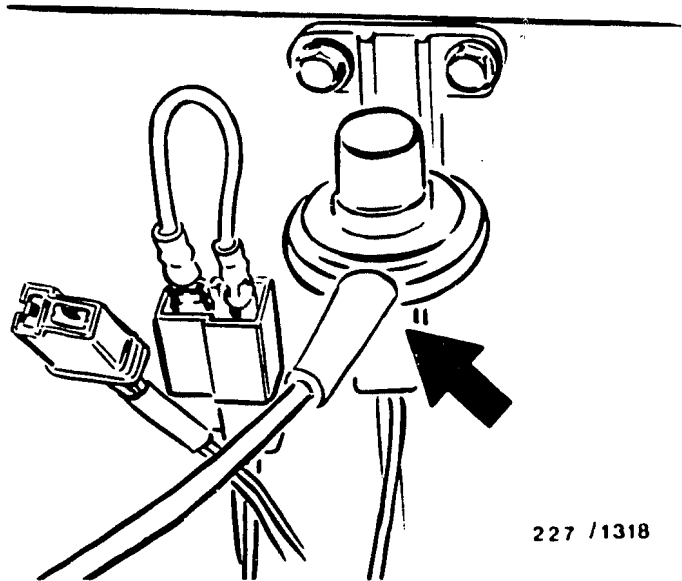


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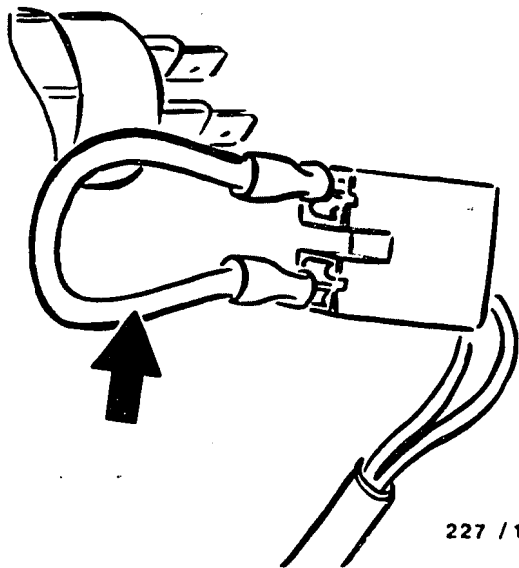


RAPID DIAGNOSIS CHART (CONTINUED)

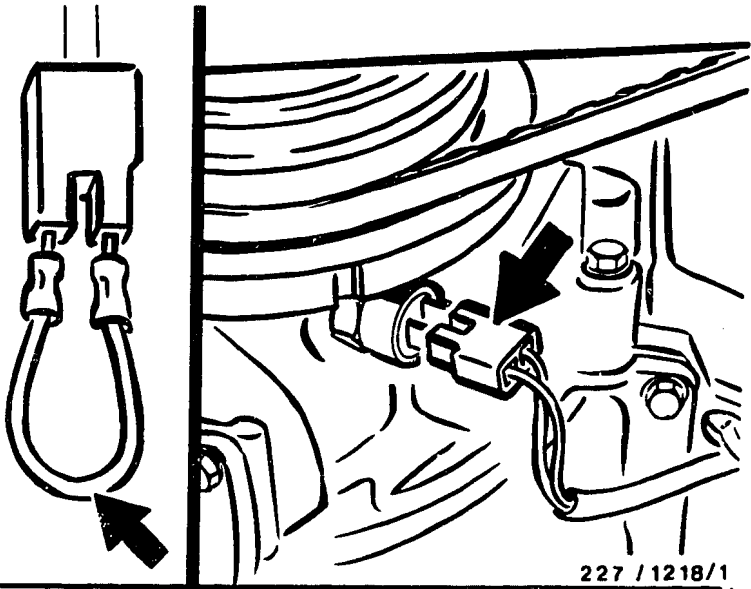
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
13	<p>CONTROL LEAD, CHARACTERISTIC CURVE CONTROL</p> <p>Detach plug of part-load switch, temperature switch (air), temperature switch (oil).</p> <p>Jumper plug with auxiliary lead in each case. See top, center and bottom pictures, arrow.</p> <p>Detach both plugs from idle-speed regulator (not illustrated).</p> <p>Detach spark-advance-unit plug (not illustrated).</p> <p>Ignition ON. Voltage, spark-advance-unit plug.</p>	3 (+)	Battery voltage
14	<p>PART-LOAD SWITCH</p> <p>Part-load-switch plug detached. Detach vacuum hose at part-load switch and connect vacuum pump to part-load switch. See top picture, arrow. Resistance, part-load switch.</p>	—	Less than approx. 90 mbar Infinity Ω (open circuit) Greater than approx. 90 mbar Approx. 0 Ω (continuity)
15	<p>TEMPERATURE SWITCH (AIR)</p> <p>Temperature-switch plug detached.</p> <p>Resistance, temperature switch. See center picture, arrow.</p>	—	Greater than approx. + 17° C Approx. 0 Ω (cont.) Less than approx. + 17° C Infinity Ω (Open circuit)



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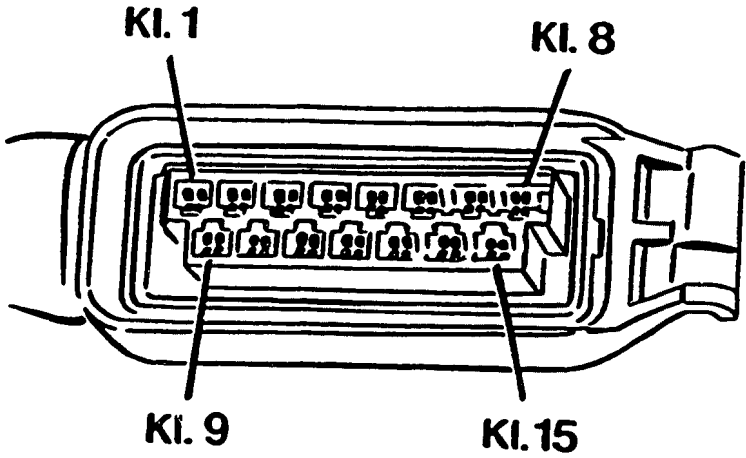
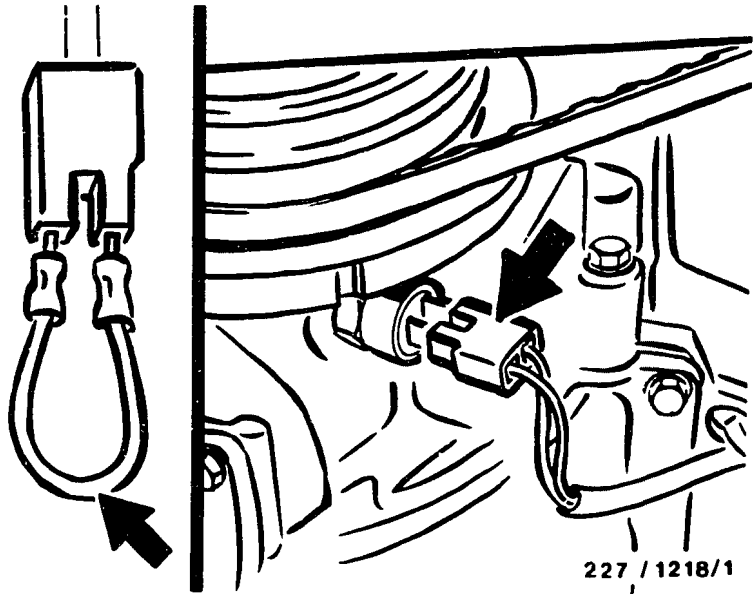
227 / 1319



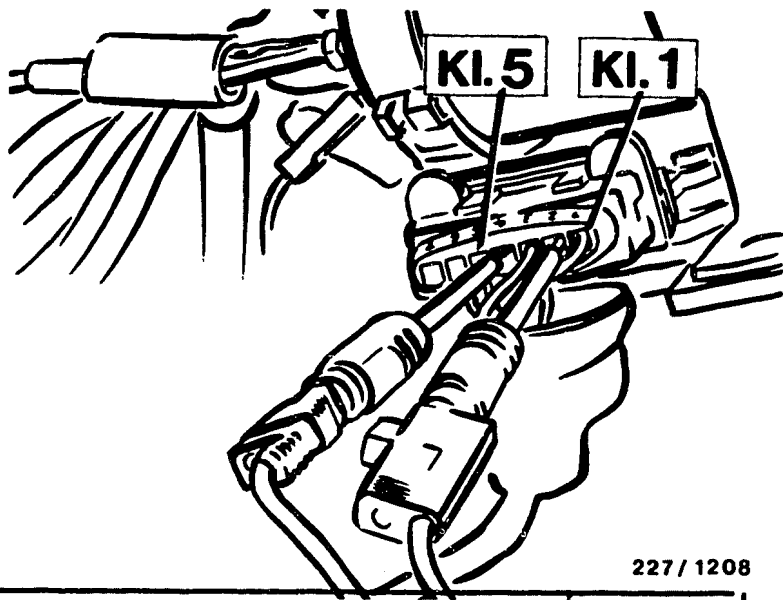
227 / 1218/1

RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
16	TEMPERATURE SWITCH (OIL) Temperature-switch plug detached. Resistance, temperature switch. See top picture, arrow.	—	Less than approx. + 65° C Approx. 0 Ω (continuity) Greater than approx. + 65° C Infinity Ω (Open circuit)
17	THROTTLE-VALVE SWITCH – IDLE/FULL LOAD Spark-advance-unit plug detached. Voltage, spark-advance-unit plug. See center picture. Throttle valve in idle position. Briefly start engine. Voltage, spark-advance-unit plug. Fully open throttle valve. Briefly start engine.	6 1 (+) (-) 14 1 (+) (-)	Approx. battery voltage Approx. battery voltage
18	VOLTAGE, TRIGGER BOX Attach spark-advance-unit plug. Push back rubber sleeve of trigger-box plug. Voltage, trigger-box plug. See bottom picture. Engine idling.	4 2 (+) (-)	12 – 14 V max. 1 V below U _B



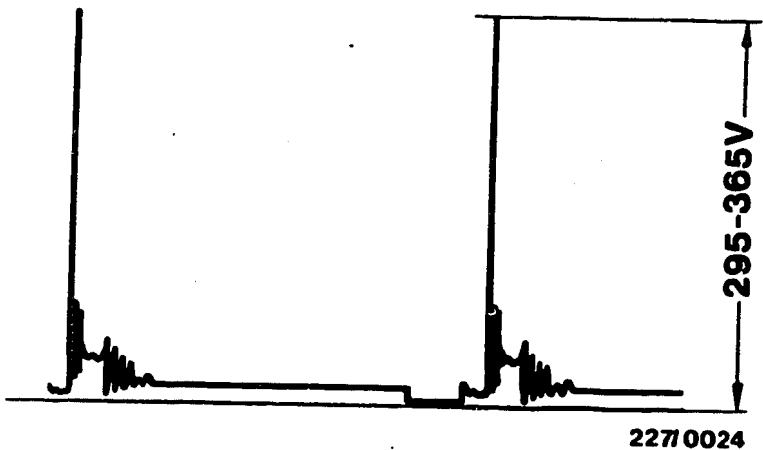
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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
19	VOLTAGE, IGNITION COIL Voltage at ignition coil and battery. Engine idling.	15 B- (+) (-)	Equal to/greater than 10 V
20	PRIMARY VOLTAGE Connect oscilloscope with pulse-shaping circuit (1 684 463 154) to ignition coil. Engine idling.	15 1* (+) (-)	295 - 365 V (See picture)



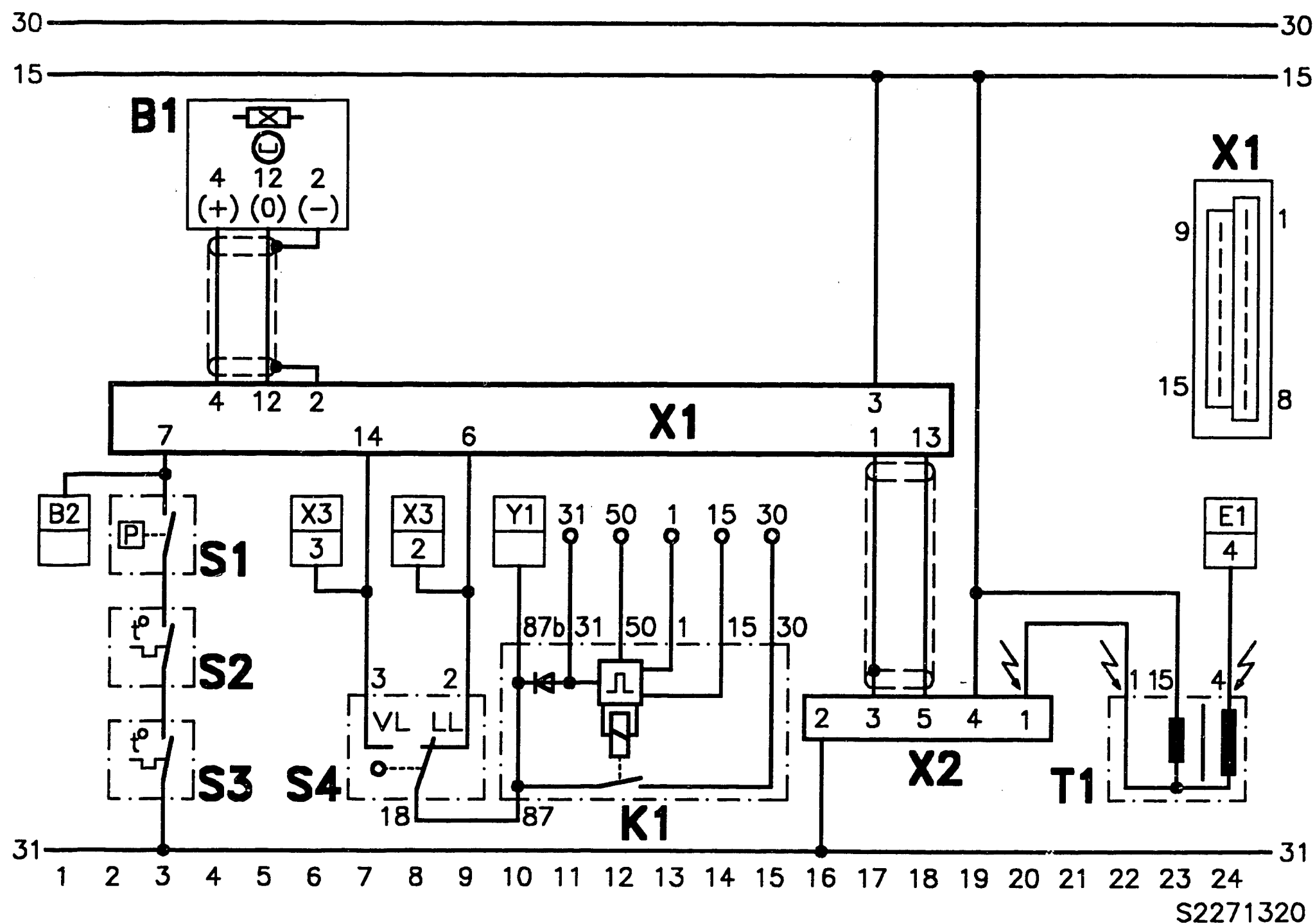
TEST SPECIFICATIONS

Ignition coil, primary	0.6...1.0 Ω
Ignition coil, secondary	6.4...11.1 k Ω
Ignition-distributor as-installed setting	Cyl. 1 10° BTDC ID-mark
Voltage, trigger box with ignition ON Battery voltage	
Voltage, primary circuit with ignition ON	Battery voltage
Voltage, magnetic pulse generator with ignition ON	Equal to/greater than 10 V
Magnetic-pulse-generator function at cranking speed	Rectangular pulse
Spark-advance-unit function at cranking speed	Rectangular pulse
Contact resistance Supply leads Trigger box Primary circuit	max. 0.3 Ω max. 0.3 Ω
Primary signal at cranking speed	Primary voltage/ engine speed display
Basic ignition setting Engine oil temperature approx.+ 80° C Throttle-valve-switch plug jumped with KDZS 0003. Detach vacuum hose, ignition distributor. Engine speed 700-1000 min ⁻¹	10° ± 2° BTDC

TEST SPECIFICATIONS (CONTINUED)

Control lead, characteristic curve control with ignition ON Part-load switch	Battery voltage Less than approx. 90 mbar Infinity Ω (open circuit) Greater than approx. 90 mbar Approx. 0 Ω (continuity)
Temperature switch (air)	Greater than approx. + 17° C Approx. 0 Ω (continuity) Less than approx. + 17° C Infinity Ω (open-circuit)
Temperature switch (oil)	Less than approx. +65° C Approx. 0 Ω (continuity) Greater than approx. + 65° C Infinity (open circuit)
Throttle-valve switch at cranking speed Idle position Full-throttle position	Approx. battery voltage Approx. battery voltage
Voltage, trigger box with engine idling	12...14 V max. 1 V below U _B
Voltage, ignition coil with engine idling	Equal to/greater than 10V
Primary voltage with engine idling	295...365 V

Please refer to SIS Jetronic microcard or Autodata test specifications for settings as regards idle speed, exhaust gas, valve clearance etc.



ELECTRICAL TERMINAL DIAGRAM

High-tension arrows: caution 400 V...25 kV

B1 = Magnetic pulse generator (ignition distributor)

B2 = to idle-speed regulator

E1 = to ignition distributor

K1 = Control relay (LE-Jetronic)

S1 = Part-load switch

S2 = Temperature switch (air)

S3 = Temperature switch (oil)

S4 = Throttle-valve switch

T1 = Ignition coil

X1 = Spark-advance-unit plug

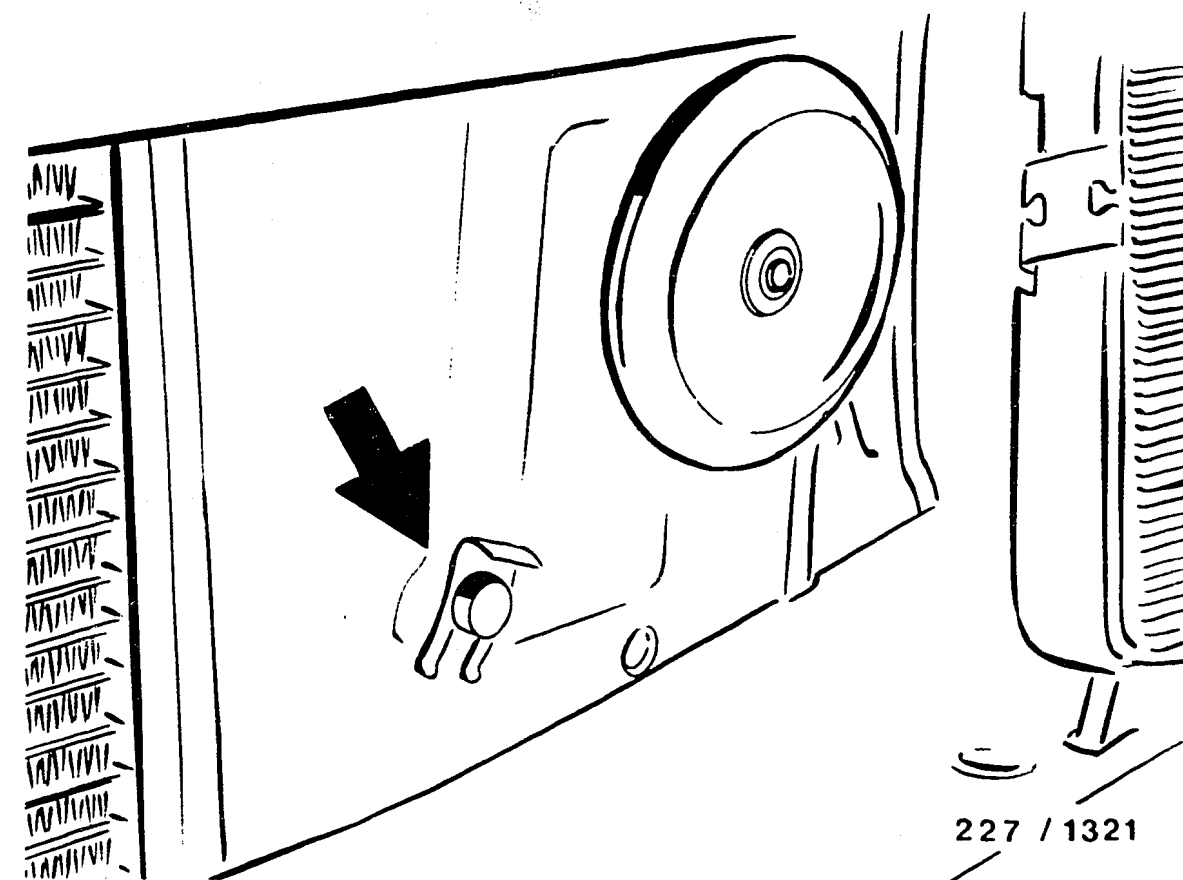
X2 = Trigger-box plug

X3 = LE-Jetronic control-unit plug

Y1 = Electric fuel pump

INSTALLATION POSITION OF COMPONENTS

- * Trigger box and ignition coil are mounted on a joint heat sink and are located beneath the windscreen washer reservoir.
- * The spark-advance unit is located at the wheel house on the left in the direction of travel.
- * The throttle-valve switch is located at the throttle-valve assembly.
- * The control relay for the LE-Jetronic is located at the engine bulkhead.
- * The part-load switch is located at the engine bulkhead (in the vicinity of the brake booster).
- * The temperature switch (oil) is located at the front of the engine on the left in the direction of travel (in vicinity of crankshaft pulley).



INSTALLATION POSITION OF COMPONENTS (CONT.)

Arrow = Temperature switch (air) is located beneath horn.
(Radiator grille removed).

Trouble-shooting instructions : BMW-5005

BOSCH system : Motronic M 1.1

Make of vehicle : BMW

Basic microcard : KFZ-00..

TABLE OF CONTENTS

Section	Coordinates
Special features	02
Structure, usage, safety and precautionary measures	04
Trouble-shooting chart	05
Self-diagnosis test table	07
Test specifications	15
Electrical terminal diagram	19
Installation position of components, notes on removal and installation	25

SPECIAL FEATURES

- These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:
- * BMW 320i, 520i with 2.0 l / 6 cyl. as of 1.87
 - BMW 325i, 325iX with 2.5 l / 6 cyl. as of 1.87
 - BMW 325e, 525e with 2.7 l / 6 cyl. as of 1.87
 - * Motronic system M 1.1 with self-diagnosis and flashing-code output (55-pole plug).
 - * The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.
- Note:
Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.
- Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).
- * As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).
- The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g.:
- | | |
|--------------------------------------|-----------------------|
| Open-circuit/short-circuit to ground | (= 1st type of fault) |
| Short-circuit to positive | (= 2nd type of fault) |

SPECIAL FEATURES (CONTINUED)

- * Control unit with variant encoding.
Important note:
Please refer to basic instructions for information which has to be given when ordering control unit.
- * Group injection: Division into 2 groups which inject at different times (except in warm-up phase and on acceleration).
Synchronization by means of sensor on ignition cable of cyl. 6.
Group 1: Cylinders 1, 3, 5
Group 2: Cylinders 2, 4, 6
- * Joint sensor for engine speed and reference mark.
- * Adaptive lambda closed-loop control and tank ventilation with pulsed valve (for cat.).
- * Control unit with built-in hold circuit (for tank ventilation valve).
- * Note on trouble-shooting:
If vehicle computer and/or burglar alarm fitted, please note the following:
If the code for depriving the system was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit.
The engine can then not be started.
For rapid testing, disconnect vehicle computer and alarm-system module and repeat attempted starting (no voltage at term. 38).

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

- * Injection and high-voltage flashovers are to be avoided when testing compression.
The main relay is therefore to be detached.

TROUBLE-SHOOTING CHART

Customer complaints (symptoms of trouble)

1.	Starting motor operates, engine fails to start or starts only with difficulty.
2.	Engine starts but but then dies.
3.	Rough idling (engine speed, exhaust gas).
4.	Poor throttle response, flat spot during acceleration.
5.	Engine misfiring (ignition, fuel injection).
6.	Maximum engine power/ top speed not reached.
7.	Fuel consumption too high.
8.	Engine running on (dieseling).
9.	Engine pinging/knocking.
10.	Engine overheating.
11.	Fault lamp.
	Cause (component fault)
*	* * * * * Self-diagnosis
*	Voltage at control unit
*	Engine-speed/reference mark sensor
*	* * * Fuel pressure
*	* * * Solenoid-operated injection valves
	* * * Throttle-valve switch
	* * * * * Air-flow sensor
	* * * Idle actuator
*	* * * Air-intake system
	* Idle speed, CO
*	* * * Ignition coil
*	* * * Primary signal
	* * * Secondary pattern
*	* * * * * Ignition point
*	* * * High-voltage sensor
	* Overrun cut-off
	* * * Interference-suppression resistors
	* * * Noise test
	* Interference
	* Throttle valve
	* Fuel delivery
*	* * * Tank vent
	* * Lambda closed-loop control
*	* * * * * Control unit

For production reasons:
continued on the following
coordinate.

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Data exchange not possible	—	—	Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	13 55 15	—
Control unit Digital sec.(comput) defective	1	1211	Control unit defective.	—	—
Relay Fuel pump Op.circ/grnd short Short to B+	3	1261	Fault 1: Short-circuit to ground or open-circuit (op. circ). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive (Short to B+): Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10...15 V Approx. 50...150 Ω
Idle actuator ZWD winding 1/EWD Op.circ/grnd short Short to B+	4	1262	Fault code 4 points to current path from control unit term. 4 to idle actuator term. 3. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 1st winding at +15...+30°C between connections 3 and 2:	4	17... 23 Ω
Valve Tank ventilation Op.circ/grnd short Short to B+	5	1263	Only CAT models have tank ventilation valve. Test lead for contact with ground or positive Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit is defective. Open-circuit (op. circ) is not detected!	5	35... 55 Ω
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	7	1215	Signal too low: Test lead to term. 2 for short-circuit to ground. Open-circuit in leads to term. 2 and term. 3 or term. 4 and term. 3 jumpered. Signal too high: Test lead to term. 4 for open-circuit. Test leads to term. 4 and term. 2 for short-circuit to positive. Continued on next Coordinate.	7 12 26	—

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Air-flow sensor/ Air-mass sensor Signal too low Signal too high			Basic tests: previous coordinates continued. Test resistances at air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Measure wiper voltage at term. 2 with plug connected and ignition switched on: Sensor flap in off position: Slowly deflect sensor flap as far as full load:		8...2500 Ω 500...1100 Ω 0,2... 0,3 V Greater than 4,2 V
Lambda control outside min. range outside max. range	10	1222	Test CO content (ahead of catalytic converter): Test intake system for leaks. Test fuel pressure. Injection valves defective. Sensor defective.	—	0,2... 1,2 vol. %
Fault lamp Op.circ/grnd short Short to B+	15	—	Test lead to fault lamp (if provided) for short-circuit to ground and short circuit to positive (short to B+). Open-circuit (op. circ) is not detected!	15	—
Injectors (Group 2) Op.circ/grnd short Short to B+	16	1252	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead. Test injection valves of cyl. 1, 3, 5 for short-circuit/ open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	16	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Injectors (Group 1) Op.circ/grnd short Short to B+	17	1251	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/ negative lead. Test injection valves of cyl. 2, 4, 6 for short-circuit/open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	17	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Idle actuator ZWD Winding 2 Op.circ/grnd short Short to B+	22	1262	Fault code 22 points to current path from control unit term. 22 to idle actuator term. 1. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 2nd winding at +15...+30°C between connections 1 and 2:	22	19... 25 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Lambda sensor Open circuit Grnd short Short to B+	28	1221	Test lead for open-circuit, short-circuit to ground and short-circuit to positive (short to B+). Watch out for worn cable insulation! Sensor heater defective. Sensor clogged.	28	_____
Speed signal incorrect/no signal	29	—	Test lead for open-circuit, short-circuit to ground and short-circuit to positive. If leads and plug connections are O.K., continue trouble-shooting in instrument cluster.	29	_____
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Test voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Test alternator regulator.	37 19 (+) (-)	Greater than 10 V (with engine running) Less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	—	Test lead to vehicle computer/burglar alarm for short-circuit to positive (short to B+). If lead and plug connections are O.K., continue trouble-shooting in vehicle computer or in burglar alarm.	38	_____
Air cond. readi- ness/AC compr. sign. Comparison not O.K.	40	—	Test lead from control unit term. 40 to A/C compressor for short-circuit to positive. Test lead from control unit term. 41 to A/C switch (A/C readiness) for open-circuit.	40 41	_____
Air-temp. sensor Op. circ./sh. to B+ Short to ground	44	1224	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (short to B+). Temperature-sensor resistance: at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278	Applies to electronic transmission control (GS): Test lead for short-circuit to ground (short to ground) or corresponding output in transmission control unit defective. Term. 51 is open on vehicles without GS.	51	_____

SELF-DIAGNOSIS TEST TALE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Idle switch Short to ground	52	1232	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	Approx. 0 Ω Infinity Ω
Full-load switch Short to ground	53	1233	Fault: Full-load contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	Approx. 0 Ω Infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	—	Note: Fault code 24 corresponds to fault code 54 Applies to electronic transmission control (GS): Test lead from control unit term. 54 for short-circuit to ground. If lead O.K., continue trouble-shooting in electronic transmission control. Term. 54 is open on vehicles without GS.	54	—
CU output stages with fin.cntling el. defective	100	—	CU = Control unit. Test following components and leads for open-circuit, short-circuit to ground and short-circuit to positive: Idle actuator, injection valves, fuel pump relay, tank ventilation valve and fault lamp if fitted.	4 22 16 17 3 5 15	—
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	—	—

TEST SPECIFICATIONS

Pressure regulator			
Fuel pressure	2,0/2,7 l:	2,3...2,7 bar	
	2,5 l:	2,8...3,2 bar	
Electric fuel pump			
Fuel delivery			
measured in return line	at least	785 cm ³ /30s	
Pre-supply pump	at least	865 cm ³ /30s	
(if present)			
Supply voltage			
(under load):	at least	12 V	
Temperature sensor (intake air)			
Internal electrical resistance			
measured at air-flow sensor			
between term.1 and term.4			
at ambient temperature			
(+15°C...+30°C):		1450...3300 Ω	
Temperature sensor (engine)			
Plug color, blue. Internal elec-			
trical resistance at			
ambient temperature			
(+ 15° C...+ 30° C):		1450...3300 Ω	
with engine at normal operating temp.			
(approx. + 80° C):		280...360 Ω	
Solenoid-operated injection valve			
Internal electrical resistance			
at ambient temperature			
(+ 15° C...+ 30° C):		14,5...17 Ω	
Air-flow sensor			
Internal electrical resistance between:			
term.2 and term.4 :		8...2500 Ω (*)	
term.3 and term.4 :		500...1100 Ω	
(*) Slowly deflect air-flow sensor flap as far as it will			
go. Fluctuating increase in resistance with slight			
drop towards end.			

TEST SPECIFICATIONS (CONTINUED)

Engine-speed/reference-mark sensor			
Internal electrical resistance			
between term.1 and term.2 at ambient			
temperature (+15°C...+30°C):		400...800 Ω	
Air gap:			0,8±0,5 mm
Throttle-valve switch			
Resistance of idle contact			
(term.2 and term.18):		0 Ω	
Resistance of full-load contact			
(term.3 and term.18):		0 Ω	
Idle actuator			
Internal electrical resistance			
at +15°...+30°C between			
term.1 and term.2 :		19...25 Ω	
term.3 and term.2 :		17...22,5 Ω	
Lambda sensor			
Resistance of heater winding			
(sockets 3 and 4 in 4-pin terminal			
to lambda sensor):		1...15 Ω	
Ignition coil			
Primary resistance:		approx. 0,8 Ω	
Secondary resistance:		5000...7200 Ω	
Interference-suppression resistors			
High-voltage-distributor rotor:		1 k Ω	
High-voltage-distributor dome:	each	1 k Ω	
Spark-plug connector:	each	5 k Ω	
Spark plugs:		5 k Ω	
Ignition coil:		1 k Ω	

TEST SPECIFICATIONS (CONTINUED)

High-voltage sensor:

Internal electrical resistance
between term. 1 and term. 2: approx. 0 Ω

Tank-ventilation valve:

(only in vehicles with catalytic converter)

Internal electrical resistance at
ambient temperature (+15°C...+30°C): 35...55 Ω

Idle test:

Engine at normal operating temperature,
switch off loads.

Idle speed: 760 \pm 40 min $^{-1}$
eta-motors 720 \pm 40° °

crankshaft

Spark-advance angle: 9 \pm 5°
crankshaft

(Automatic transmission to N or P)

CO content: without

catalytic converter: 1,0 \pm 0,5 % CO by vol.

Adjust mixture at the bypass screw
in the air-flow sensor:

turning to the left makes mixture leaner,
turning to the right makes mixture richer.

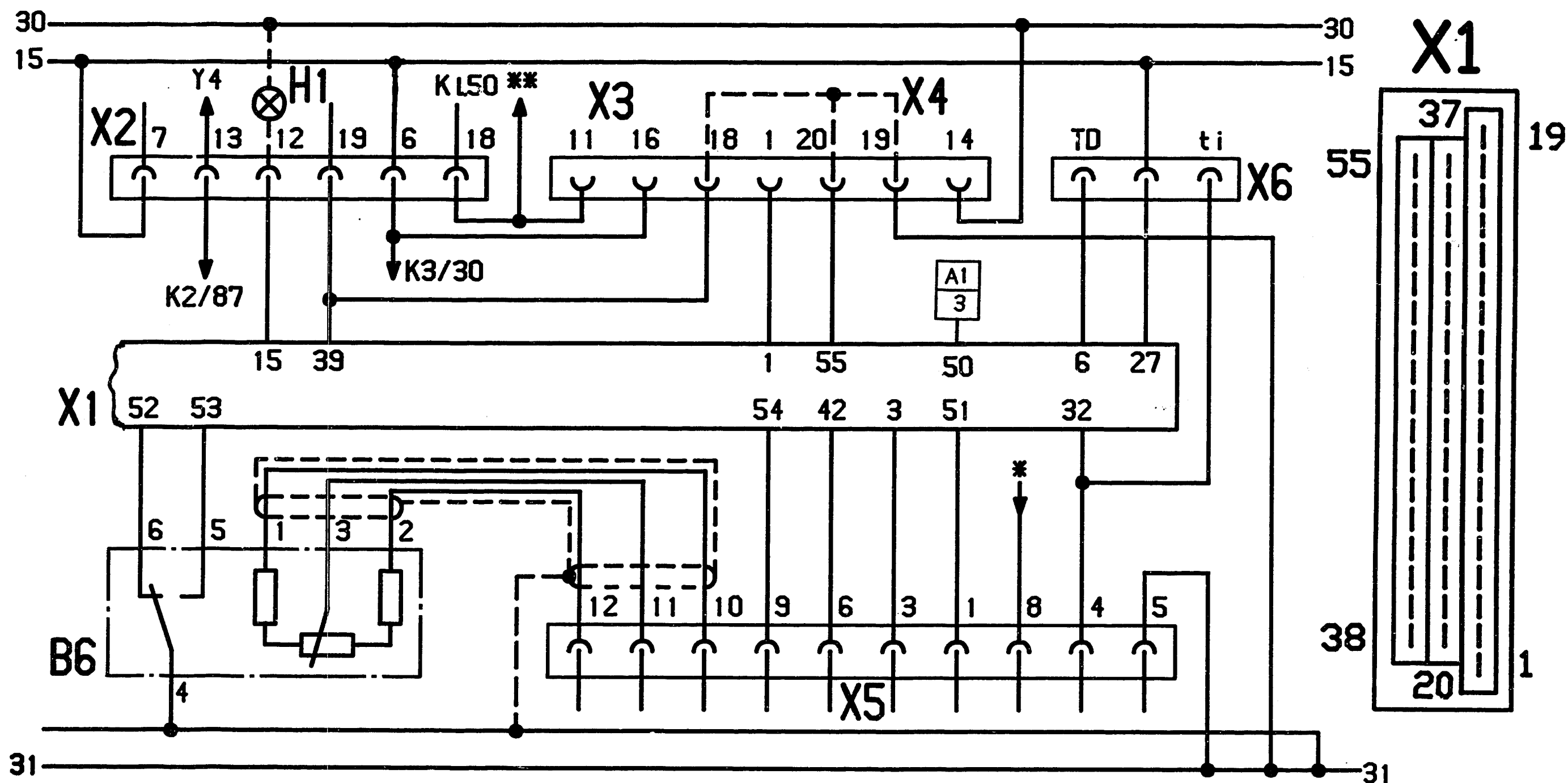
Vehicles with

catalytic converter: 0,7 \pm 0,5 % CO by vol.

(measure CO upstream of the catalytic
converter if sampling pick-up fitted,
pull apart lambda-sensor plug).

For production reasons:
continued on the following
coordinate.

See equipment and Autodata microcards for
the settings for valve clearance and other
engine-related data.



ELECTRICAL TERMINAL DIAGRAM (continued, 3 Series)

A1 = ABS control unit (325 ix only)

B6 = Throttle-valve switch with potentiometer
(with electro. transm. control for item S1)

H1 = "CARB" lamp (fault lamp; US version)

K3 = Main relay

K2 = Pump relay

X1 = Motronic control-unit plug

X2 = Engine plug (20-pin)

X3 = Diagnosis plug (20-pin)

X4 = Jumper in diagnosis-plug cover

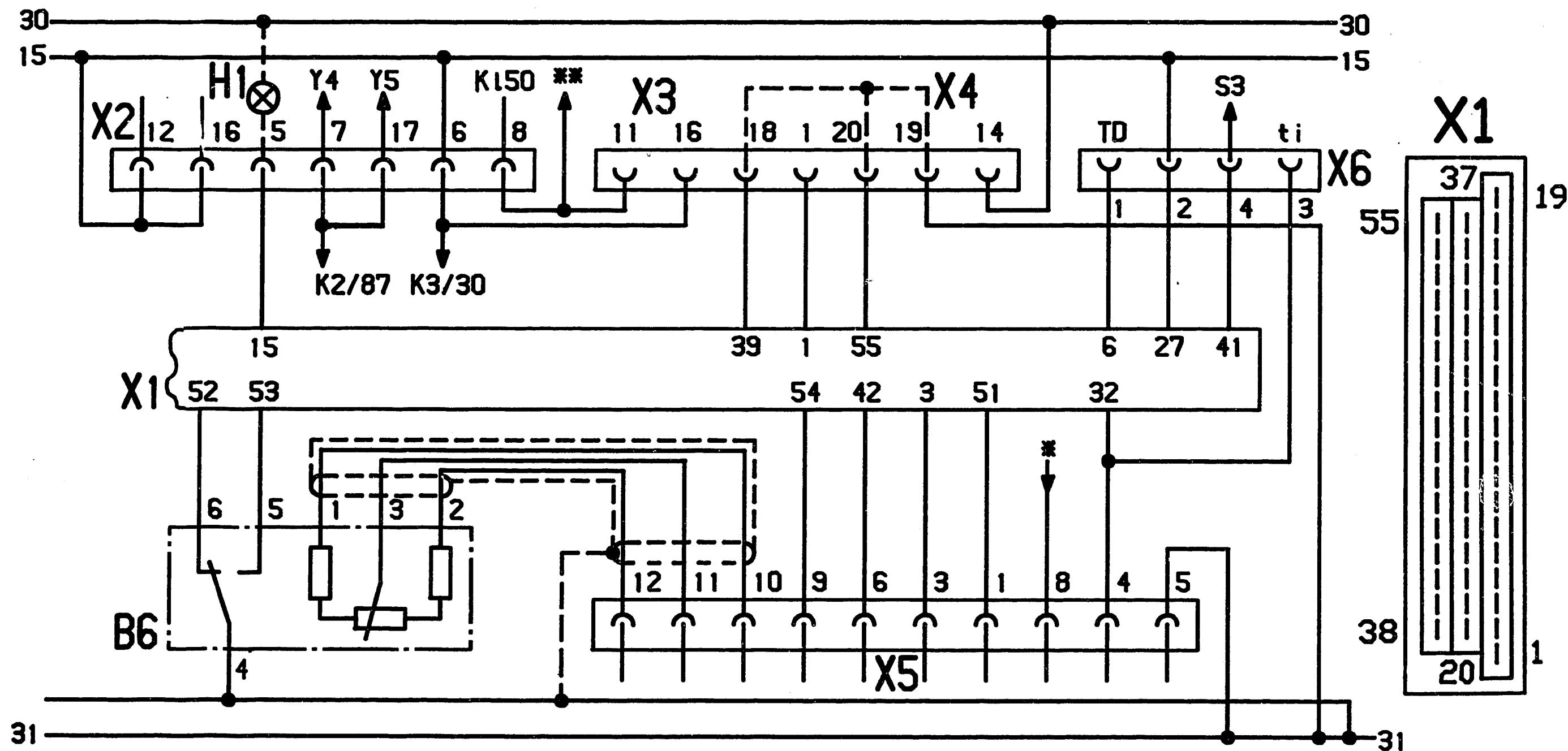
X5 = 13-pin plug to transmission control unit

X6 = 3-pin connector

Y4 = Electric fuel pump

* = from main relay term.87(+)

** = to starting motor term.50

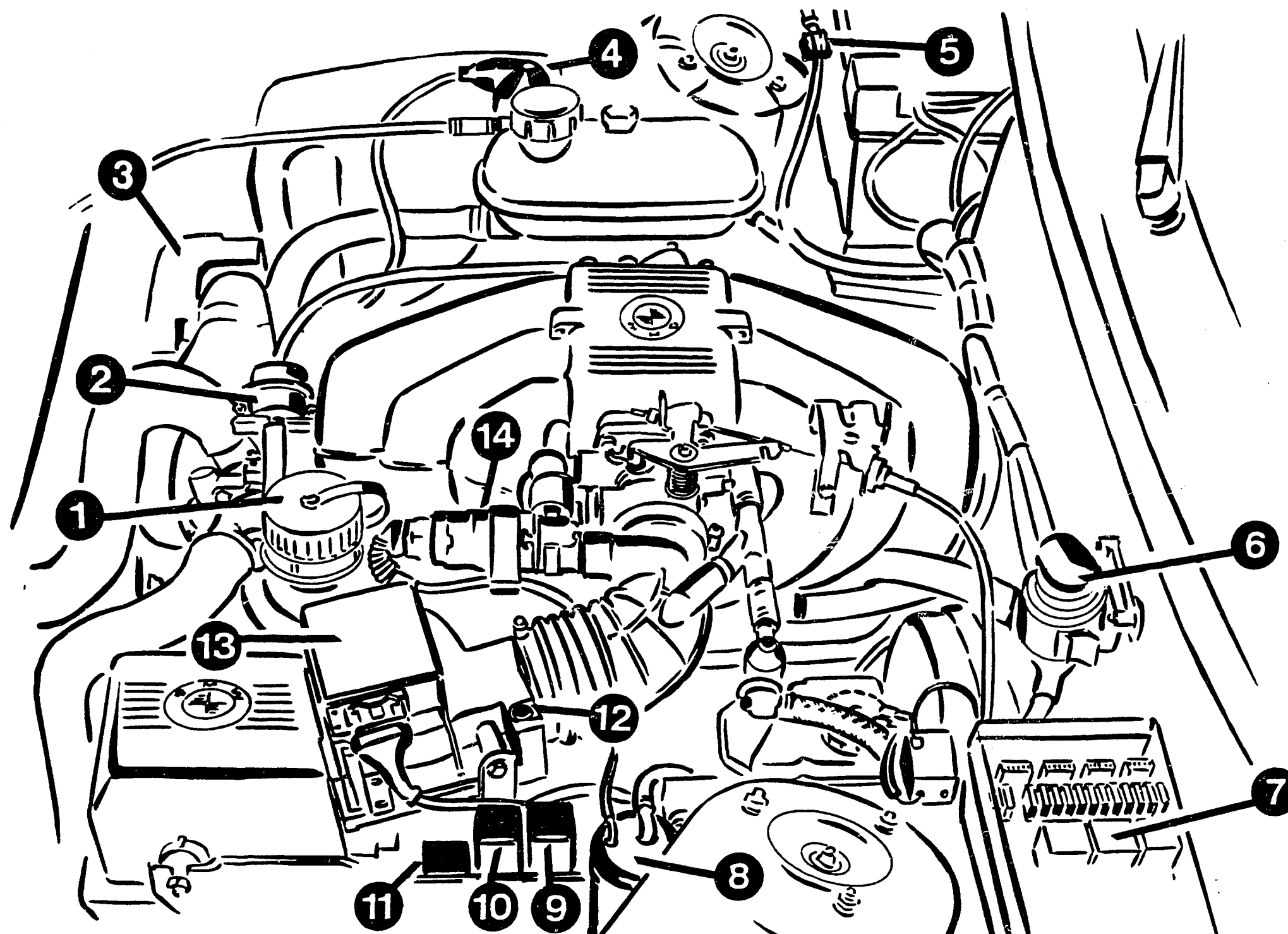


ELECTRICAL TERMINAL DIAGRAM (continued, 5 Series)

B6 = Throttle-valve switch with potentiometer
(with electro. transm. control for item S1)
H1 = "CARB" lamp (fault lamp; US version)
X1 = Motronic control-unit plug
X2 = Engine plug (20-pin)
X3 = Diagnosis plug (20-pin)

X4 = Jumper in diagnosis-plug cover
X5 = 13-pin plug to transmission control unit
X6 = 6-pin connector

* = from main relay term.87(+)
** = to starting motor term.50



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INSTALLATION POSITION OF COMPONENTS (3201)

- | | | |
|------------------------------|---|----------------------|
| 1 = Diagnostic socket | 7 = Fuse box | 13 = Air-flow sensor |
| 2 = Fuel-pressure regulator | 8 = Active carbon canister (cat only) | 14 = Idle actuator |
| 3 = High-voltage distributor | 9 = Sensor-heater relay (color: orange) | |
| 4 = Ignition coil | 10 = Pump relay (color: orange) | |
| 5 = Motronic ground terminal | 11 = Main relay (color: white) | |
| 6 = Engine plug | 12 = CO adjusting screw | |

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The installation locations always refer to the direction of travel.

Control unit:

In glove compartment above cover.

High-voltage sensor:

On high-tension ignition cable to cylinder 6.

Plug connection for high-voltage sensor:

Next to oil dipstick (top picture, Item 1)

Engine-speed/reference-mark sensor:

At front of engine, to right of crankshaft ring gear.

Plug connection for engine-speed/reference-mark sensor:

Next to oil dipstick (top picture, Item 2).

Lambda sensor:

In joint exhaust pipe (center picture, Item 1).

Plug connection for lambda sensor (round, 4-pole):

Beneath battery (center picture, Item 2).

Tank ventilation valve:

In engine compartment beneath throttle-valve assembly (bottom picture, arrow).

Temperature sensor (air):

In air-flow sensor.

Electric fuel pump and fuel pressure damper:

Beneath vehicle on left.

Fuse No. 11 for electric fuel pump:

In fuse box at bulkhead, left.

Fuel filter:

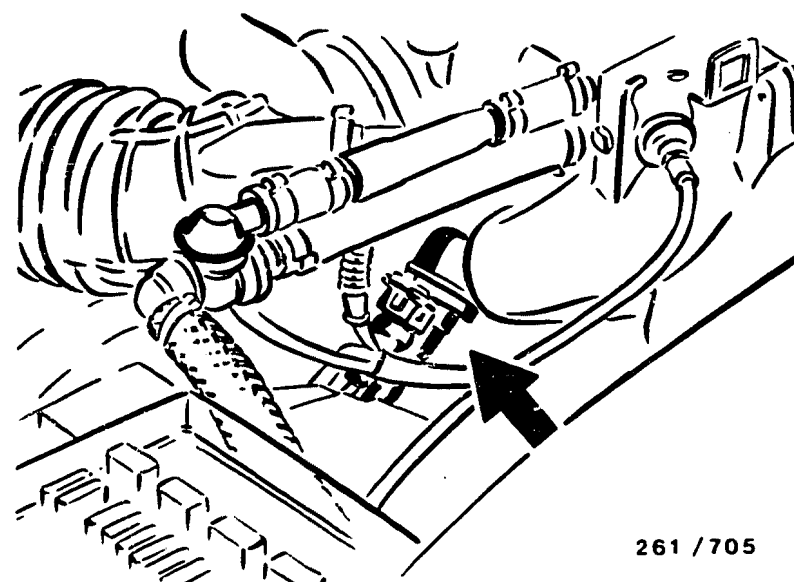
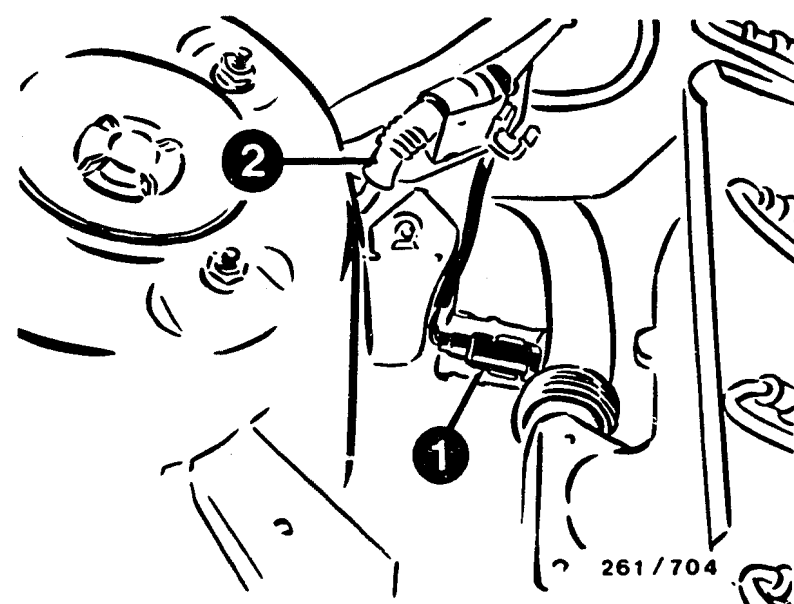
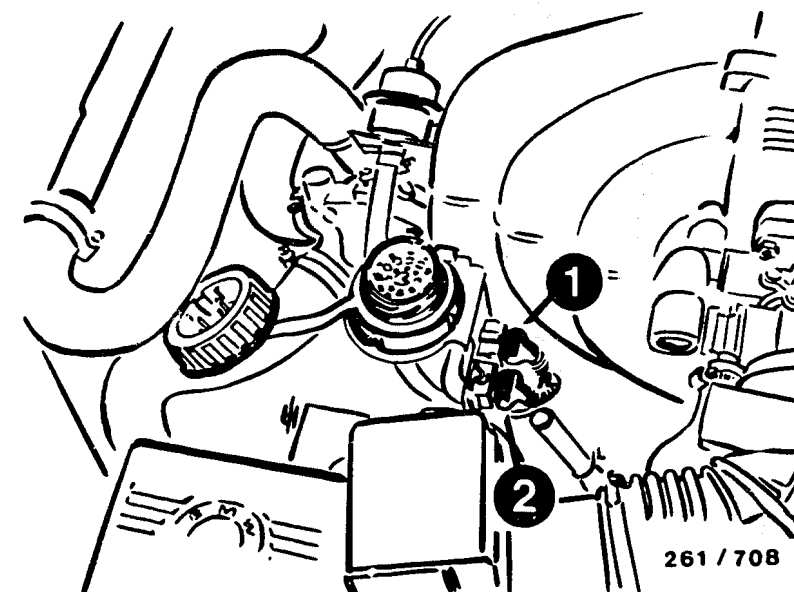
On left of engine compartment, next to bulkhead.

Temperature sensor (coolant)

Next to injection valve of cyl. 1.

Throttle-valve switch:

At bottom of throttle-valve assembly.



STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Prevent fuel from being injected during the compression test.
For this reason, disconnect control relay.

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)										
*	*	*	*	*	*	*	*	*	*	Universal test adapter
*										Electric fuel pump
*	*	*	*							Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*			Air-flow sensor/air-mass sensor
*	*	*	*		*					Intake system
		*	*	*		*	*			Solenoid-operated injection valves
*	*	*			*	*				Fuel pressure
				*	*					Fuel quantity
		*	*	*	*	*				Throttle valve
			*							Overrun cut-off
*		*								Start control
			*							Ground
*	*	*	*	*	*					Alternator, interference suppress.
		*	*	*		*				CO exhaust-gas adjustment
			*							Control unit
						*				Catalytic converter
	*	*	*	*						Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
 Adapter lead: 1 684 463 123

Test step	Switch V Ω	Termi- nals	Checking of component/function	Test instructions/ test conditions	Set values
1	5 —	1 — 5 (+) (-)	TD-engine speed signal from Microplex ignition control unit	Shift into neutral, start	Square-wave voltage min. 80% U-bat.
2	6 —	9 — 5 (+) (-)	Voltage from control relay term. 87	Shift into neutral, start	8...15 V
3	7 —	4 — 5 (+) (-)	Voltage from ignition/ starting switch term. 50	Shift into neutral, start	8...15 V
4	 V	11	8 — 5 Resistor combination in air-flow sensor		100...200 Ω
5	 V	12	7 — 5 Resistance of potentiometer in air-flow sensor	Deflect sensor flap as far as it will go	60...1000 Ω
6	 V	13	10 — 5 Resistance, temperature sensor (engine)	Ambient temperature +15...+30°C; Engine at operating temperature approx. +80°C;	1,45...3,3 k Ω 280...360 Ω
7	 V	14	13 — 5 Ground connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
8	 V	16	2 - 9	Resistance of idle contact	Accelerator pedal in rest position : Slightly depress accelerator pedal :	0...10 Ω infinity Ω
9	 V	17	3 - 9	Resistance of full-load contact	Accelerator pedal in rest position : Fully depress accelerator pedal :	infinity Ω 0...10 Ω
10	 V	18	12 - 9	Resistance of shunt- connected solenoid-oper- ated injection valves	+15...+30°C : Approx. +80°C :	6,8... 9,5 Ω 7,0...10,0 Ω

REMARK: The following components with respective connecting leads are not covered by the universal test adapter for these tests:

- 1. Auxiliary-air device: positive lead from term. 87 of control relay, negative lead to engine ground.
- 2. Electric fuel pump: positive lead from term. 87b of control relay (via pump fuse), negative lead to vehicle ground.
- 3. Sensor heater: positive lead from term. 87b of control relay (via sensor fuse), negative lead to engine ground.
- 4. Lambda sensor: sensor lead to control unit term. 20 (shielding to term. 5), sensor housing to vehicle ground.

TEST SPECIFICATIONS

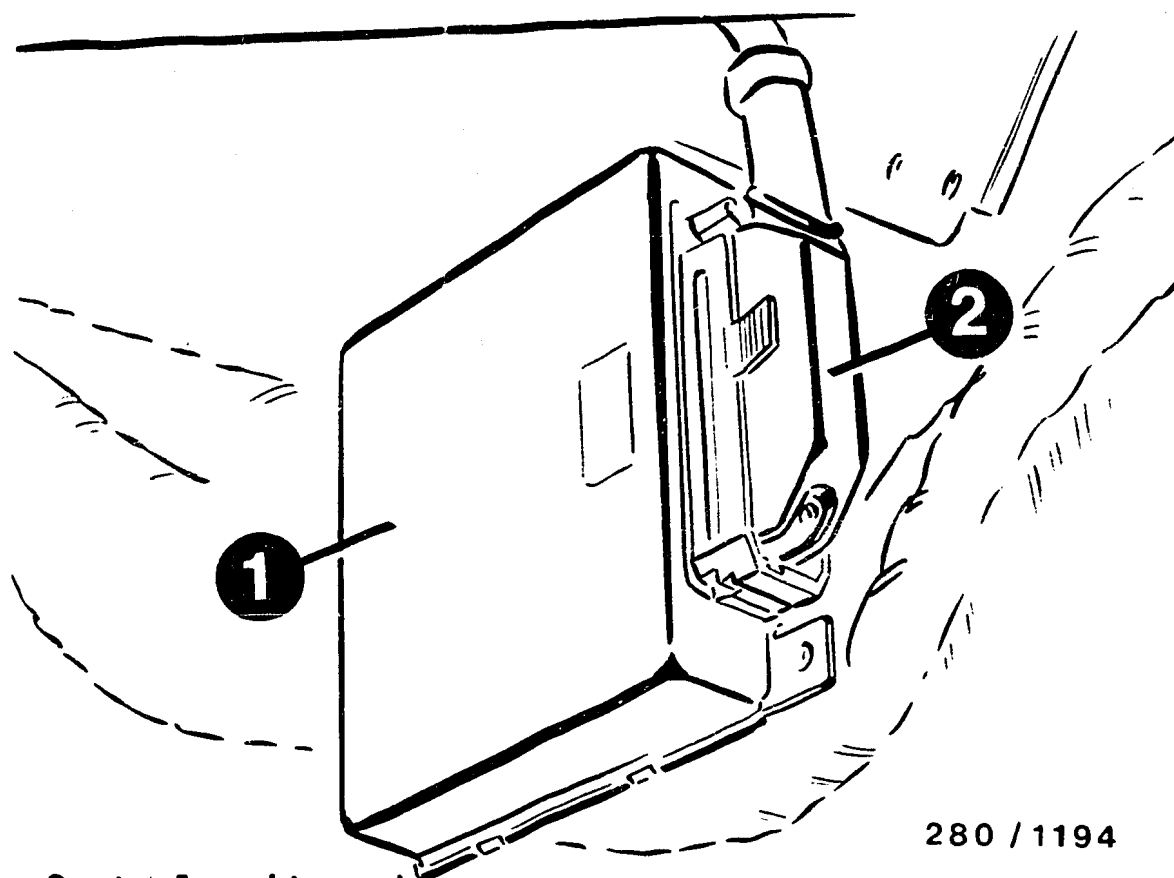
Component/function	Set values
Electric fuel pump	
* Fuel delivery and return:	at least 700 cm ³ /30 s
* Supply voltage under load:	at least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill:	2,8...3,2 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	at least 1.0 bar
Auxiliary-air device	
* Resistance value	40...75 Ω
Air-flow sensor	
* Resistance value between term. 8 and term. 5:	340 ... 450 Ω
term. 7 and term. 5:	60 ...1000 Ω 1)
term. 9 and term. 5:	500 ... 760 Ω
term. 8 and term. 9:	160 ... 300 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1,45...3,3 k Ω
With engine at warm. op. temp. approx. +80°C :	280...360 Ω
Lambda-sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

TEST SPECIFICATIONS (Continued)

Component/Function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14,5...17,5 Ω
* Leakage after 60s:	no drop must fall
Start control	
* Voltage at injection valve on initiation of starting:	greater than 1.5 V
after approx. 15s:	approx. 0.5 V
Idle adjustment	
Engine at normal op. temp., approx. +80°C	
* Idle speed:	800...900 min ⁻¹
CO adjustment	Integrator voltage
Engine at norm. op. temp., (test pin term. 22) approx. +80°C	
* Open-loop control (pull apart plug-in connection of sensor lead):	fixed voltage value between 5 ... 9 V
* Closed-loop control (connect up plug-in connection):	indicator fluctuates between 2 voltage values
* Adjustment:	mean value with closed-loop control same as with open-loop control

* Rich value (pull apart plug-in connection and apply control-unit lead to ground):	10...13 V
* Lean value (apply 2V to control-unit lead):	less than approx. 1.0 V

See equipment and Autodata microcards for the setting values for ignition, valve clearance and other engine-related data.



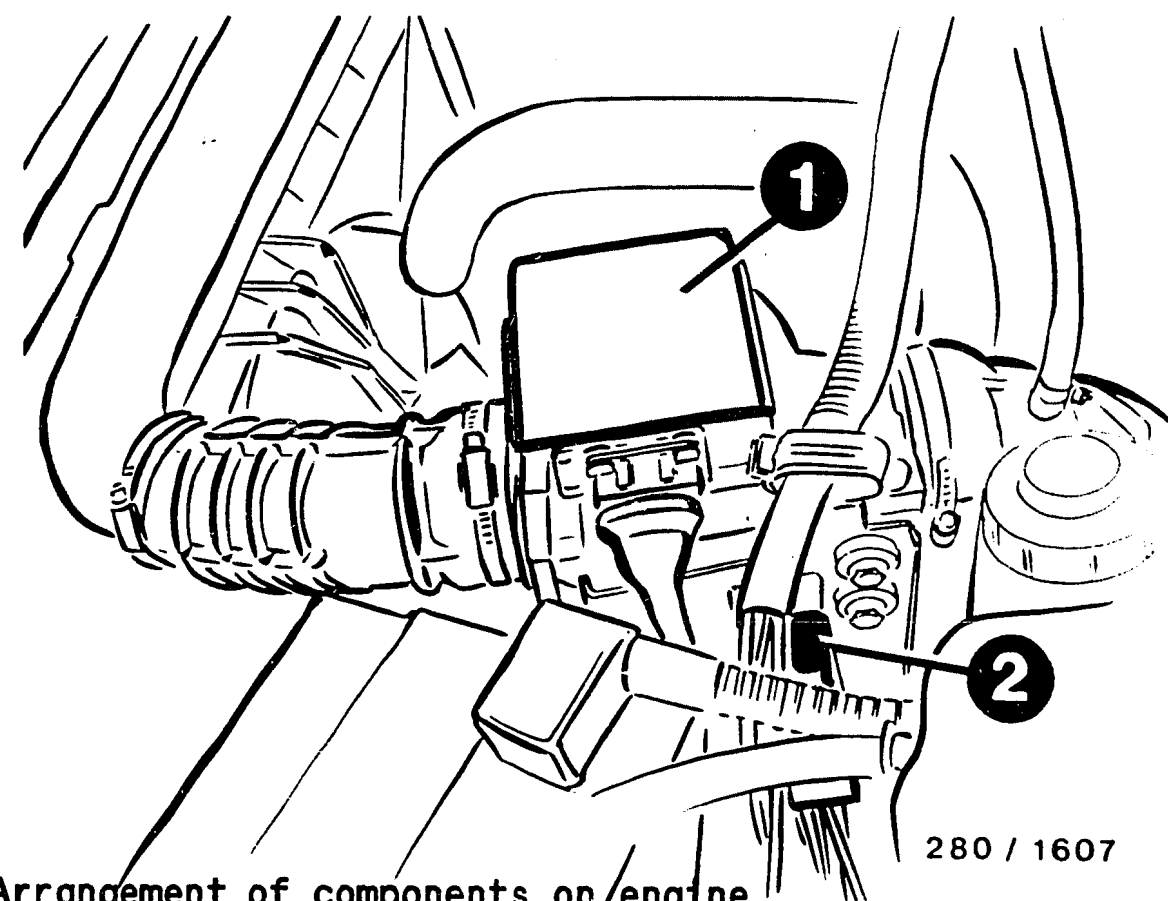
- 1 = Control unit
2 = 25-pole control-unit plug

INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel.

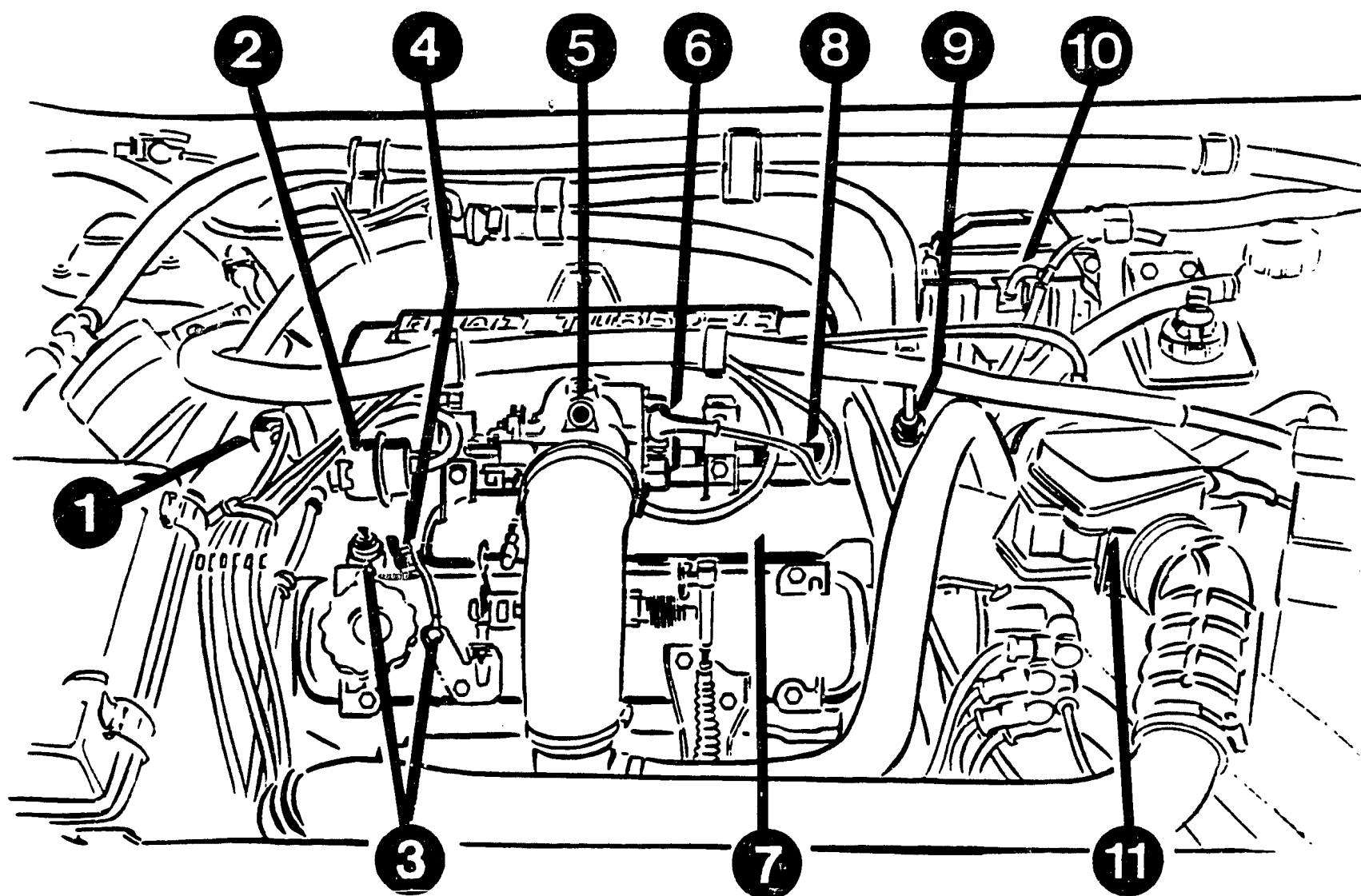
The LU-Jetronic control unit is located in the passenger compartment beneath the glove compartment.

For electrical testing with universal test adapter, press open catch (locking lug) and detach control-unit plug. Connect 25-pole adapter lead to detached control-unit plug (peripheral testing only).



* Arrangement of components on engine

- 1 = Air-flow sensor
2 = Control relay

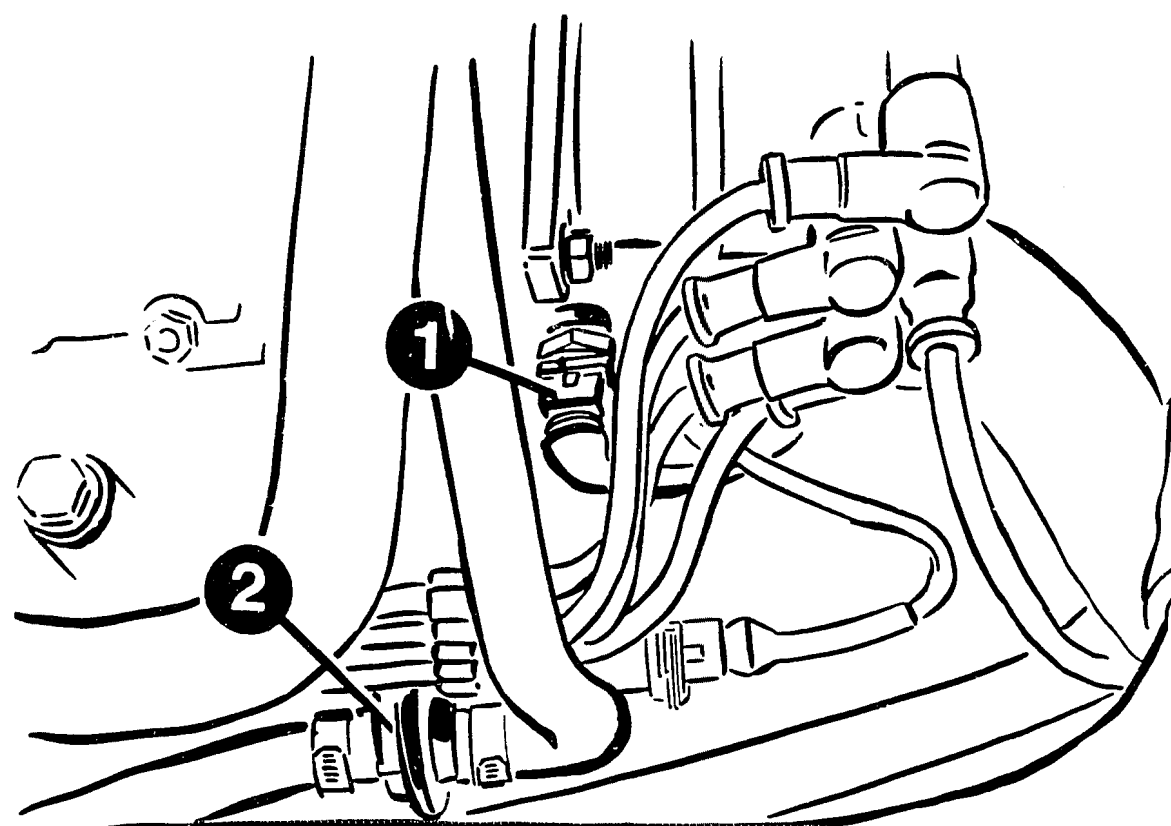


280 / 1608

- 1 = Fuel filter
- 2 = Pressure regulator
- 3 = Ground connections
- 4 = Solenoid-operated injection valves

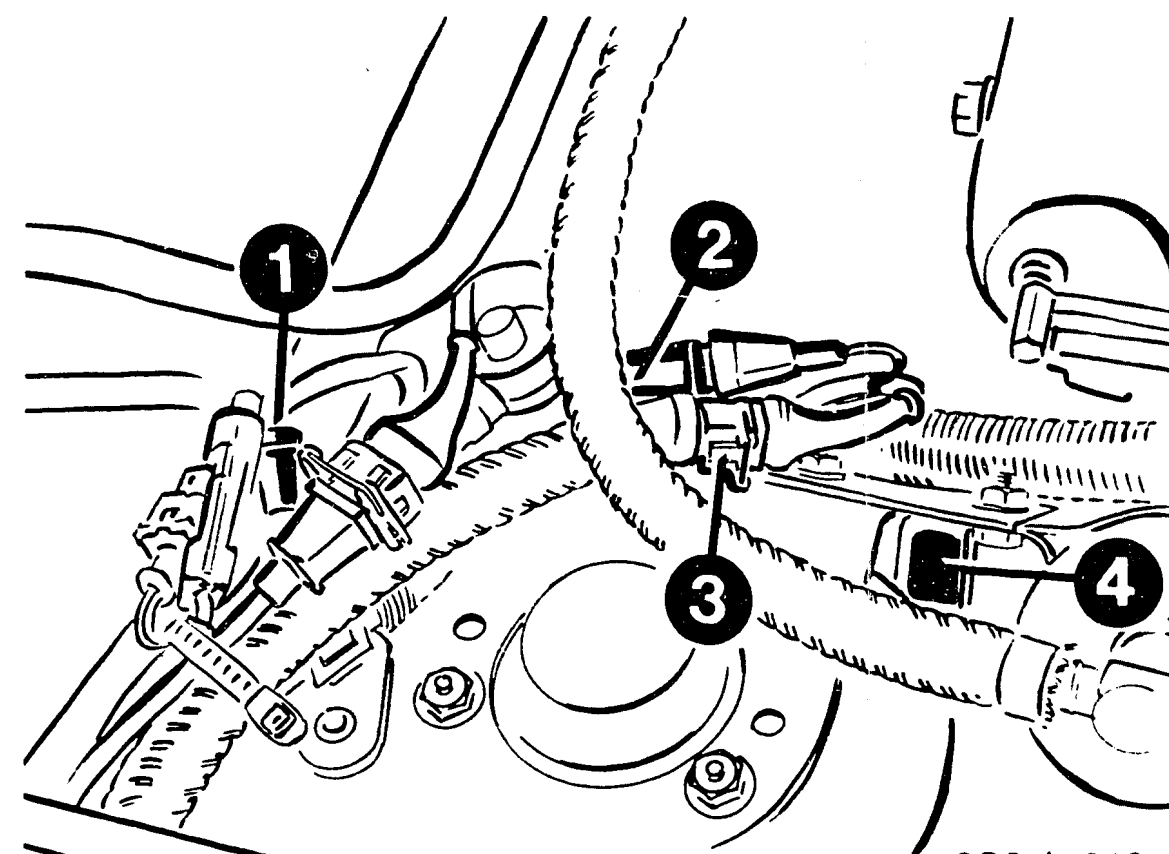
- 5 = Idle-speed bypass screw
- 6 = Throttle-valve switch
- 7 = Air distributor and thermoswitch
for injection-valve cooling

- 8 = Fuel-distribution pipe
- 9 = Fuel inlet line
- 10 = Microplex ignition control unit
- 11 = Air-flow sensor



280 / 1609

- 1 = Temperature sensor (engine)
- 2 = Auxiliary-air device



280 / 1610

- 1 = Test pin term. 22 from control unit, integrator voltage of lambda closed-loop control.
- 2 = Plug connection for lambda-sensor signal
- 3 = Plug connection for sensor heater
- 4 = Fuel filter

Other component installation positions

- * The lambda sensor is screwed in at the exhaust pipe ahead of the catalytic converter.

Fuel supply components

- * Prefilter and electric fuel pump with fuel-line-pressure damper are arranged in a transverse manner in front of the fuel tank.

TABLE OF CONTENTS

Trouble-shooting instructions : LAI-5003

BOSCH system : Air-conditioning control

Make of vehicle : LANCIA

Basic microcard : KFZ-00..

Section	Coordinate
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Self-diagnosis.....	09
Test specifications.....	13
Electrical terminal diagram.....	15
Installation position of components.....	19

SPECIAL FEATURES

- * This microcard, valid at the time of publication, contains trouble-shooting instructions for the A/C system on the following LANCIA models:
Thema (09.84 ->)
- * The heating section of the A/C system features air-blending.
- * Adjustment of the mixing and air distribution flap is effected by way of motors with checkback potentiometers.
- * The control unit is fitted with self-diagnosis. Any faults occurring in the system are stored in the fault memory. The control unit makes use of specified substitute values should a sensor fail.

The self-diagnosis is activated by simultaneously pressing the AUTO and VENT buttons on the operating unit and releasing the AUTO button first. As of model year 88, the self-diagnosis is activated by simultaneously pressing the ECON and VENT buttons on the operating unit and releasing the ECON button first. The self-diagnosis is read out by way of the temperature set-value display on the operating unit.
- * The operating program of the A/C system was modified as of 03.86. Following switch-on of the ignition, the A/C system no longer starts in the "AUTO" program, but rather in the "ECON" program.

SPECIAL FEATURES (continued)

Test checkback voltage of positioning motor of air distribution flap and mixing flap:

Pull operating unit together with control unit out of centre console.
Switch on ignition. Using multimeter at connected control-unit plug with suitable test prods, check term. with respect to term.25

Set air distribution	Set value
"VENT" : (0,72...0,75xUp)	3,61...3,72 V
"BI-LEV": (0,58...0,61xUp)	2,93...3,01 V
"FLCOR" : (0,49...0,51xUp)	2,47...2,53 V
"HEAT" : (0,37...0,4xUp)	1,88...1,97 V
"DEF" : (0,25...0,28xUp)	1,29...1,39 V

The checkback voltage is a function of the air distribution preselected on the operating unit.

Using multimeter at connected control-unit plug check term.17 with respect to term.25:

Temperature desired value	Set value
"HI": (0,26...0,28xUp)	1,30...1,40 V
"LO": (0,72...0,75xUp)	3,60...3,70 V

Note: Only read off set value after air distribution flap/mixing flap has attained pre-selected position. The way in which the values depend on the potentiometer supply voltage Up is indicated in brackets.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

- * Never perform welding work on parts of the closed refrigerant system or in their immediate vicinity. Heat generation results in an extremely high overpressure which can lead to system damage or to an explosion. Refrigerant decomposes to form hydrogen chloride and hydrogen fluoride when exposed to flames or high temperatures. These decomposition products are injurious to health.

The system must be drained when performing repairs on the refrigerant circuit. Gaseous refrigerant must not be allowed to escape into the open air (protection of environment), but rather it must be drawn off via an evacuation station. Used refrigerant is to be returned to the refrigerant manufacturer for disposal. Never allow refrigerant to get into the eyes or onto the skin! Wear protective goggles! Keep body away from refrigerant as it emerges (danger of freezing)!

Measures designed to prevent damage to motor, control units, and peripheral components of the A/C system must be heeded.

For production reasons:
continued on the following
coordinate.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1.	No or poor heating capacity	
2.	No or poor cooling capacity	
3.	Heating blower cannot be regulated	
4.	Incorrect air distribution	
5.	Recirculation not possible with AUTO operation	
6.	Temperature desired value is not stored with ignition "OFF"	
7.	AUTO operation not possible	
8.	Ambient temperature indicator (as of model year 88) not functioning	
9.	Illumination, operating unit defective.	
	Cause (component fault)	
*	*	Self-diagnosis evaluation
*		Coolant level too low
*		Check refrigerant level
*		Defroster defective
*		Drier defective
*	*	Compressor actuator defective
*	*	Pressure switch defective
*		Condenser dirty
*	*	Check blower regulator

TROUBLE-SHOOTING CHART (continued)

Customer complaint (fault symptoms)

1.	No or poor heating capacity	
2.	No or poor cooling capacity	
3.	Heating blower cannot be regulated	
4.	Incorrect air distribution	
5.	Recirculation not possible with AUTO operation	
6.	Temperature desired value is not stored with ignition "OFF"	
7.	AUTO operation not possible	
8.	Ambient temperature indicator (as of model year 88) not functioning	
9.	Illumination, operating unit defective.	
	Cause (component fault)	
*	*	Checkback potentiometer incorrectly set or defective
*	*	Adjustment flaps defective
*	*	Blower motor defective
	*	Motor of fresh-air/recirculating-air flap defective
*		Check sensor blower
	*	Control unit defective
	*	Repair illumination

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions / Test conditions	Termi- nals	Set values
1U	Passenger-compartment temperature sensor (open circuit or short circuit)	Check resistance of passenger-compartment temperature sensor: at 15°C	3 12	approx. 15,8...16,2 k Ω
1C		at 20°C Eliminate open circuit or short circuit in leads. Renew passenger-compartment temperature sensor.	3 12	approx. 7,8... 8,2 k Ω
2U	Ambient temperature sensor (open circuit or short circuit)	Check resistance of ambient temperature sensor: at 15°C	16 12	approx. 920... 924 Ω
2C		at 30°C Eliminate open circuit or short circuit in leads. Renew ambient temperature sensor.	16 12	approx. 0,98...1,02 k Ω
3U	Discharge temperature sensor (open circuit or short circuit)	Check resistance of discharge temperature sensor: at 20°C	4 12	approx. 12,2...12,8 k Ω
3C		at 30°C Eliminate open circuit/short circuit in leads. Renew discharge temperature sensor.	4 12	approx. 7,8... 8,2 k Ω
5U	Mixing flap motor (open circuit or short circuit)	Check winding resistance of mixing flap motor: Check insulation resistance of mixing flap motor: Checkback potentiometer; check overall resistance: Wiper resistance in adjustment range:	6 7 6 13 19 25 17 25	less than 100 Ω greater than 1 M Ω approx. 0,9...1,4 k Ω approx. 1,0...2,4 k Ω
5C	Mixing flap motor (wrong direction of rotation)	Eliminate open circuit/short circuit in leads. Check connection of mixing flap motor in accordance with circuit diagram.		
6U	Air-distribution flap motor (open circuit or short circuit)	Check winding resist. of air-distribution flap motor: Check insulation resist. of air-distrib. flap motor: Checkback potentiometer; check overall resistance: Wiper resistance in adjustment range:	8 9 8 13 19 25 5 25	less than 100 Ω greater than 1 M Ω approx. 0,9...1,4 k Ω approx. 1,0...2,4 k Ω
6C		Eliminate open circuit/short circuit in leads. Check connection of air-distribution flap motor in accordance with circuit diagram.		

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions / Test conditions	Termi- nals	Set values
7U	Fresh-air/recirculating- air flap motor	Check winding resistance of fresh-air/recirculating- air flap motor: Check insulation resistance of motor: Open circuit or short to ground (phase 1 or 2) in lead to motor, fresh-air/recirculating-air flap. <u>Motor, fresh-air/recirculating-air flap defective.</u>	11 10 11 13	less than 100 Ω greater than 1 M Ω
7C		Short circuit in motor or motor blockage.		
9U	Relay, refrigerant compressor coupling	Check winding resistance of compressor relay: (Temperature and pressure switch are connected in series with compressor relay) Eliminate open circuit or short circuit in lead to compressor relay. Pressure switch, temperature switch or compressor relay defective.	23 13	less than 80 Ω
9C				
AU	Blower control and blower motor	Connect up control unit. Switch on ignition. Check control voltage to blower regulator: Blower speed 1: 22 13 approx. 0,7 V Blower speed 2: 22 13 approx. 1,2...1,6 V Blower speed 3: 22 13 approx. 3,0...5,0 V Eliminate open circuit/short circuit in leads to blower regulator. Blower regulator defective.	22 13 22 13 22 13	approx. 0,7 V approx. 1,2...1,6 V approx. 3,0...5,0 V
AC				
EU	Control unit	Control unit defective.	—	—

TEST SPECIFICATIONS

Internal resistance

Passenger-compartment
 temperature sensor 16,2...7,8 k Ω
 at 15...20°C

Discharge temperature
 sensor 1,7...7,8 k Ω
 at 20...30°C

Ambient temperature
 sensor 0,922...1,02 k Ω
 at 15...30°C

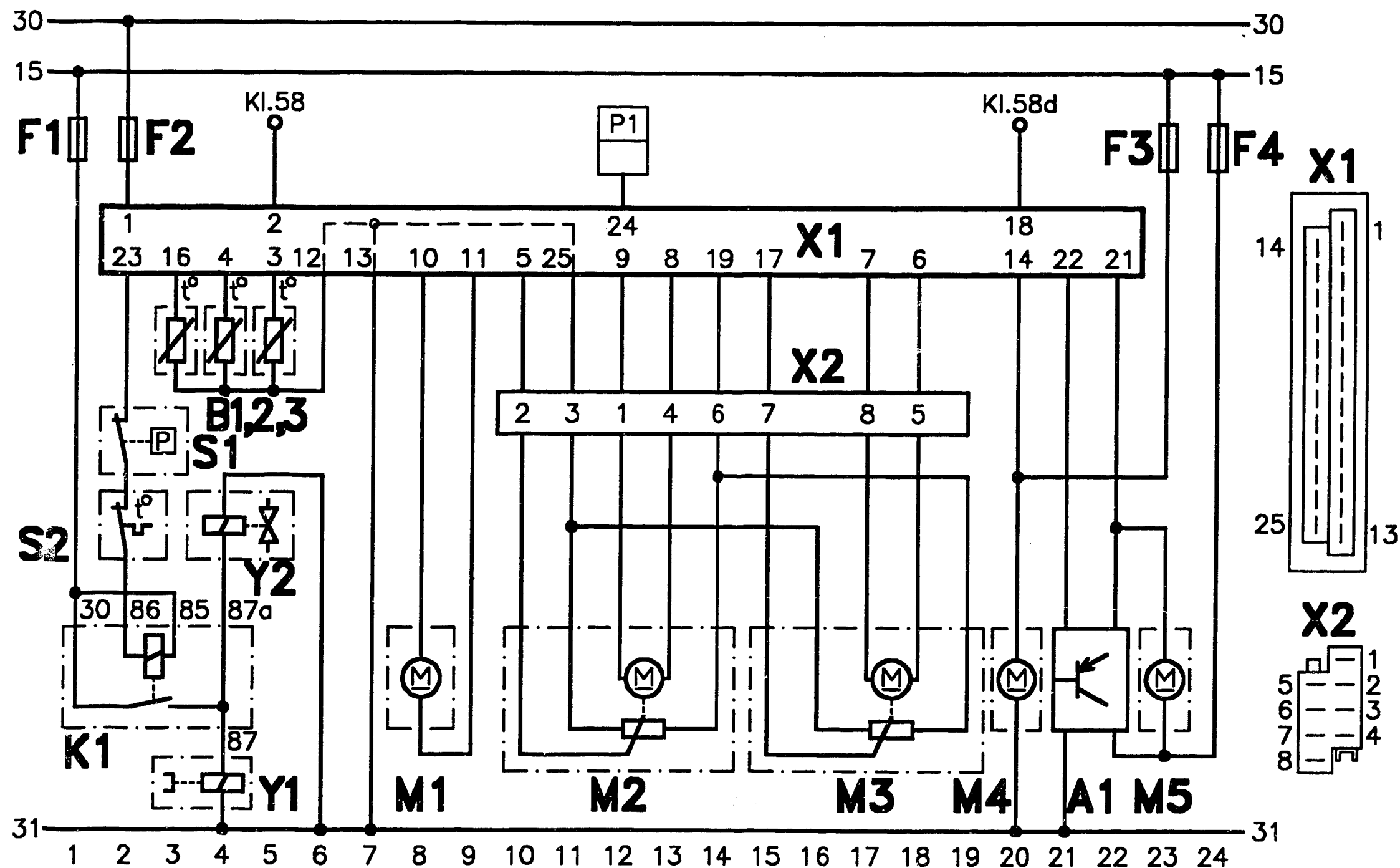
Motor, fresh-air/re-
 circulating-air flap
 Winding resistance less than 100 Ω

Positioning motor, mixing
 and air distribution flap
 Winding resistance less than 100 Ω

Checkback potentiometer
 Overall resistance: 1,9...2,8 k Ω
 Resist. in adjustment range: 1,0...2,4 k Ω

Blower regulator:
 Control voltage approx. 0,7...5,0 V
 Blower-motor current 0...25 A

For production reasons:
 continued on the following
 coordinate.



S1410334

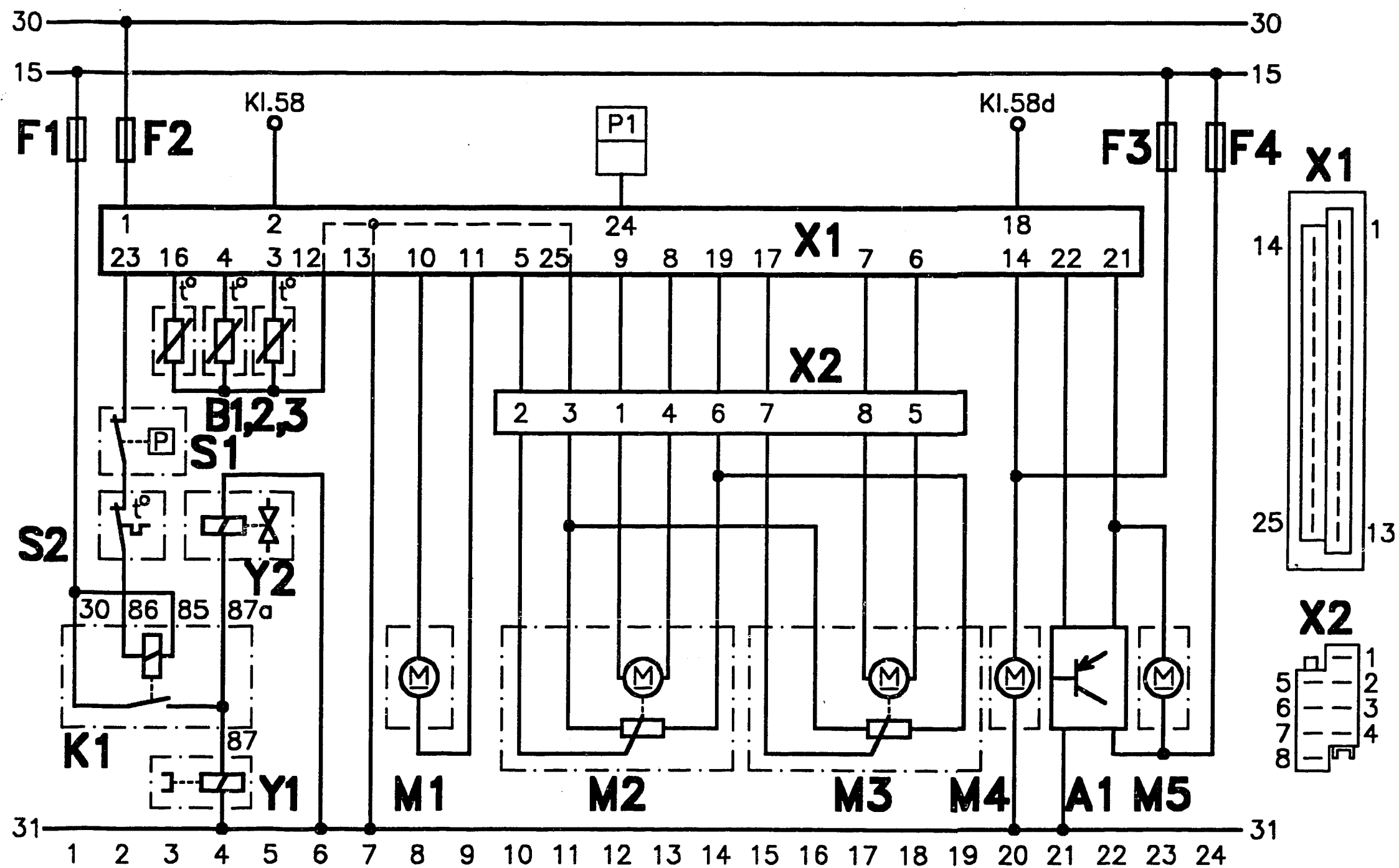
A1 = Blower regulator
 B1 = Ambient temperature sensor
 B2 = Discharge temperature sensor
 B3 = Passenger-compartment temperature sensor
 F1...F4 = Fuses, central-electrics console
 K1 = Relay, refrigerant compressor
 M1 = Motor, fresh-air/recirculating-air flap

M2 = Stepping motor, air distribution flap
 M3 = Stepping motor, mixing flap
 M4 = Suction blower for passenger-compartment temperature-sensor ventilation
 M5 = Blower motor
 S1 = Pressure switch
 S2 = Defroster switch

ELECTRICAL TERMINAL DIAGRAM, A/C SYSTEM

L15 —————>

L16 —————>



S1410334

- P1 = Instrument cluster
 X1 = Plug, control unit with operating unit (term. 12,
 term. 13 and term. 25 internally connected in CU)
 X2 = Plug, flap adjustment unit
 Y1 = Magnetic coupling, refrigerant compressor
 Y2 = Solenoid valve for idle increase

ELECTRICAL TERMINAL DIAGRAM, A/C SYSTEM (CONTINUED)

INSTALLATION POSITION OF COMPONENTS

The operating unit with built-in control unit is located in the centre console (top picture).

To remove, take out radio or shelf insert and press operating unit with integrated control unit from behind out of retaining clips.

Note: As of model year 88, the control unit features an integral ambient temperature indicator. The ambient temperature can be displayed on the desired value indicator by switching displays.

Replacing defective bulb or operating-unit illumination:

Remove operating unit together with control unit.

Plug-in bases with bulbs are inserted from the rear into the housing of the operating unit.

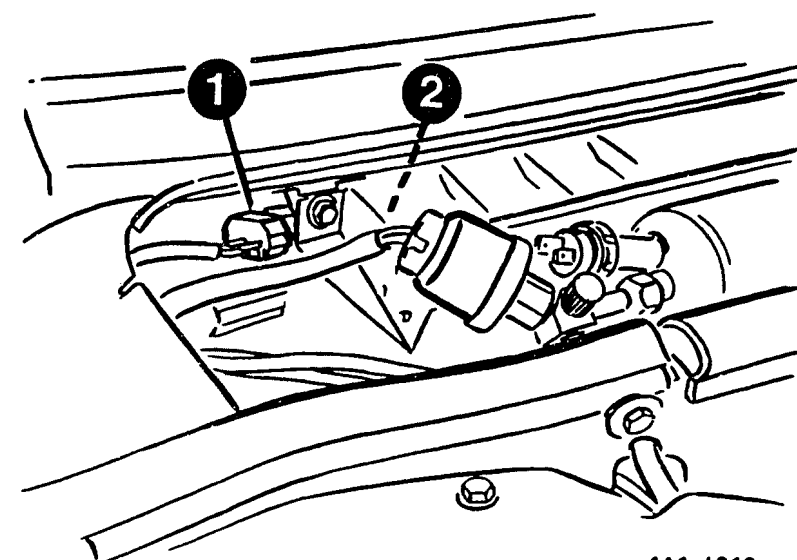
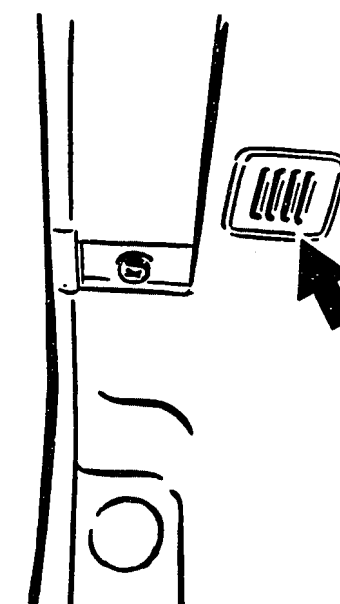
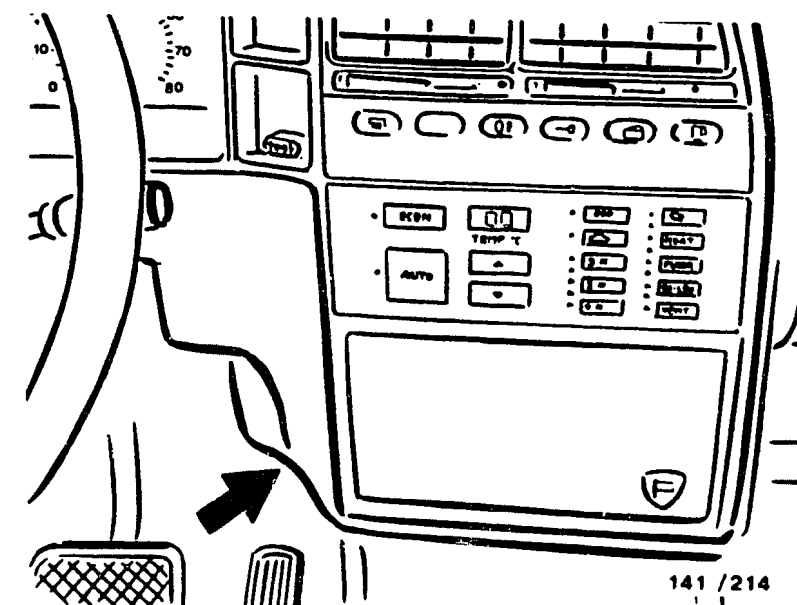
The passenger-compartment temperature sensor is installed in the left-hand footwell next to the centre console (centre picture; or top picture, arrow).

Note: The passenger-compartment temperature sensor was moved to the roof area (not illustrated) as of model year 88.

The passenger-compartment temperature sensor is vented by way of a suction blower (installed behind glove compartment on servomotor unit).

The fresh-air/recirculating-air flap drive and the ambient temperature sensor (bottom picture, 1 and 2) are installed in the engine compartment.

Note: As of model year 88 the ambient temperature sensor was moved to the left-hand rear-view mirror (not illustrated).



INSTALLATION POSITION OF COMPONENTS (continued)

The flap adjustment unit consists of the air-distribution-flap drive (top picture, 1) and the mixing flap drive (2).

The flap adjustment unit is located beneath the glove compartment at the heater housing.

Take out glove compartment to effect removal/installation.

The flap adjustment unit is attached to the heater housing with 2 screws.

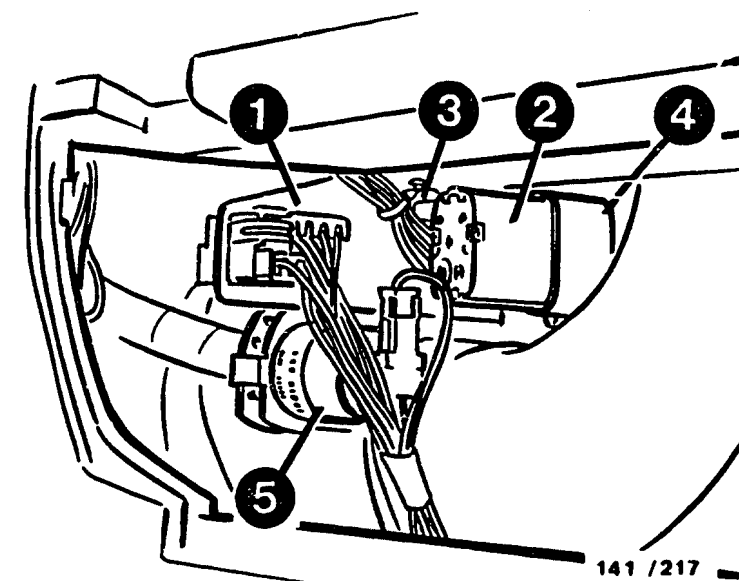
The mixing flap is adjusted by way of the cable (top picture, 3) and the distribution flap v_a the adjustment mechanism (4).

The suction blower for the passenger-compartment temperature-sensor ventilation is attached to the flap adjustment unit (top picture, 5).

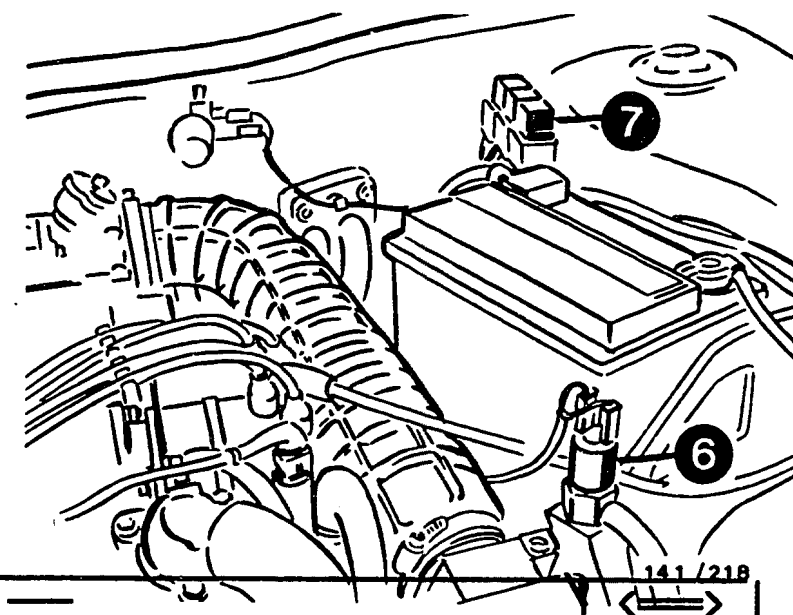
The discharge temperature sensor (not illustrated) is clipped into the air distribution housing on the left.

To effect removal, insert screwdriver between discharge temperature sensor and heater housing and press out discharge temperature sensor.

The switching valve for idle speed increase is attached to the battery bracket next to the air-flow sensor, whereas the compressor relay is attached to the left-hand engine bulkhead behind the battery (bottom picture, 6 and 7).



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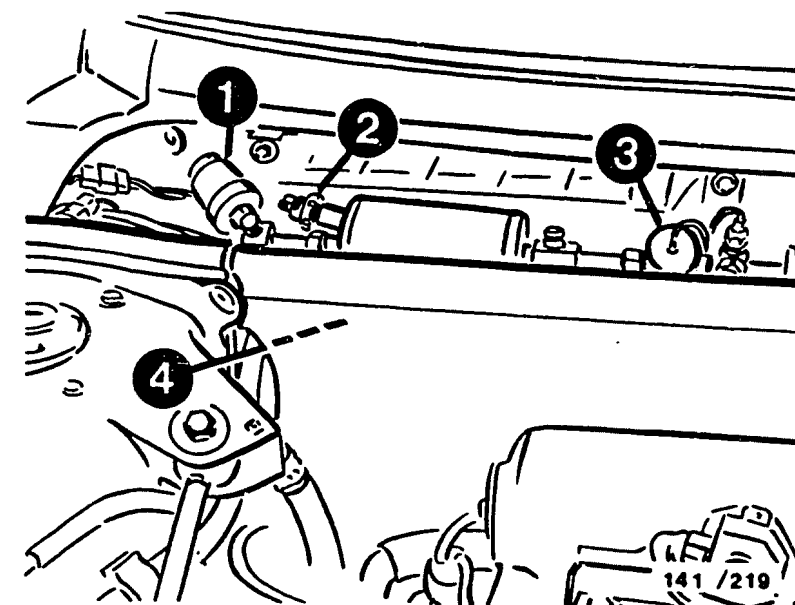
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INSTALLATION POSITION OF COMPONENTS (continued)

The high-pressure, low-pressure and de-icer switches are arranged in the engine compartment (top picture 1, 2 and 3) beneath the cover (already removed in picture).

The blower regulator with heat sink is installed in the blower housing. The intermediate wall (top picture, 4) is to be taken out for removal and installation of the blower regulator.

When installing a new blower regulator, the blower-regulator contact surface is to be smeared with thermolube 5 942 860 003.
Note: Thermolube is toxic!



Trouble-shooting instructions : ALF-5013
BOSCH system : EZ
Make of vehicle : ALFA-ROMEO
Basic microcard : KFZ-00.

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Alfa-Romeo model:

Alfa 33 1.7 ie
4-cyl. engine 4.88 ->

- * Ignition distributor 0 237 507 ...
- * Trigger box 0 227 100 111
(with current limitation).
- * Spark-advance mechanism 0 227 921 038
- * Ignition coil 0 221 600 002
- * Temperature and load-dependent ignition characteristic-
curve switching.
- * The set values given in these brief instructions apply
only to Bosch products.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on.
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

Cause (component fault)									
*			*						High-tension side
*	*	*	*	*					Ignition coil
*	*								Firing sequence
*									Voltage, spark-advance mechanism
*									Voltage, trigger box
*									Voltage, primary circuit
*									Ignition-distributor plug and socket
*									Magnetic pulse generator, voltage supply
*									Magnetic-pulse-generator function
*									Spark-advance-mechanism function
*									Ignition-distributor as-installed setting
*									Primary signal
*									Contact resistance (primary side)
*									Engine-speed signal, Jetronic

TROUBLE-SHOOTING CHART (CONTINUED)

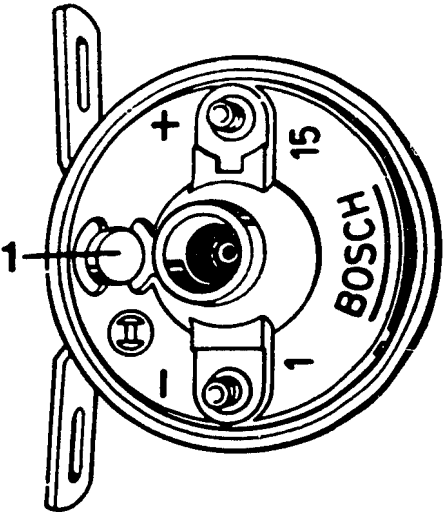
Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.
- Fault lamp.

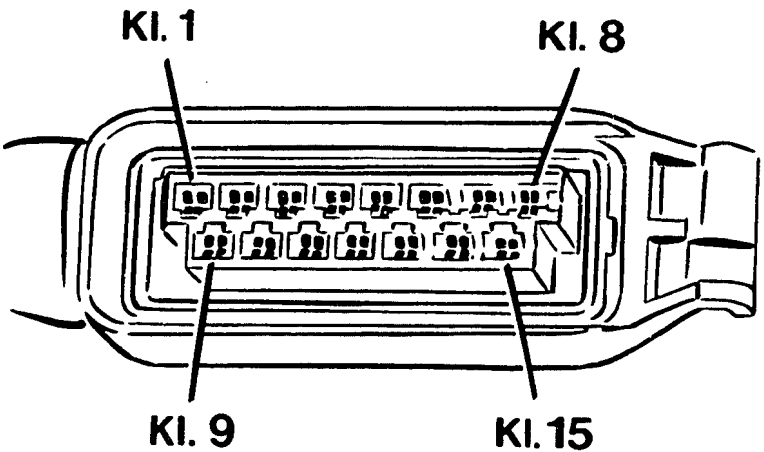
Cause (component fault)									
	*	*		*	*		*	*	Temperature switch
	*	*		*	*		*	*	Throttle-valve switch (idle)
									Throttle-valve switch (full load)
	*	*		*	*		*	*	Basic ignition setting
			*						Voltage, trigger box with engine idling
			*						Voltage, ignition coil with engine idling
			*						Primary voltage with engine idling

RAPID DIAGNOSIS CHART

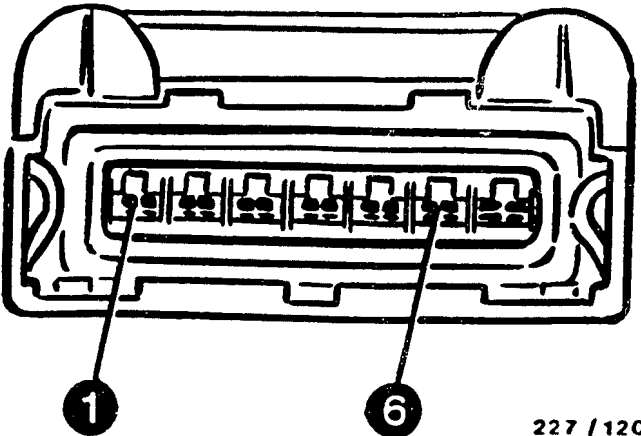
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
1	HIGH-TENSION SIDE Check function of for example spark plugs, ignition harness and distributor cap (e.g. open circuit, shunt,. Assess for example by way of ignition oscillo- gram, resistance measurement, visual inspection.	—	—
2	IGNITION COIL Visual inspection: plug (1) present, sealing compound oozed out? See top picture. Resistance, primary. Resistance, secondary.	<div>1 15</div> <div>1 4</div>	<div>0,7... 1,2 Ω</div> <div>6,9...11,9 k Ω</div>
3	VOLTAGE, SPARK-ADVANCE MECHANISM Detach spark-advance-mechanism plug. Trigger-box plug attached. Voltage, spark-advance-mechanism plug See center picture. Ignition ON.	<div>3 1</div> <div>(+) (-)</div>	Battery voltage
4	VOLTAGE, TRIGGER BOX Detach trigger-box plug. Voltage, trigger-box plug. See bottom picture. Ignition ON.	<div>4 2</div> <div>(+) (-)</div>	Battery voltage
5	VOLTAGE, PRIMARY CIRCUIT Trigger-box plug detached. Voltage, trigger-box plug. See bottom picture. Ignition ON.	<div>1 2</div> <div>(+) (-)</div>	Battery voltage



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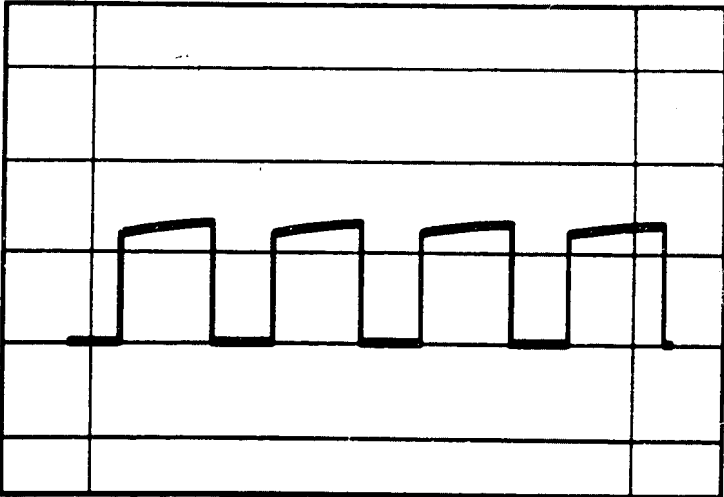
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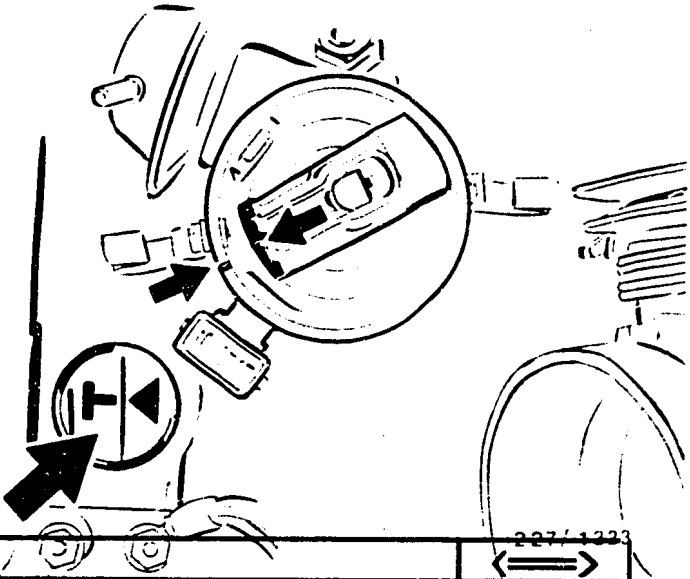
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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
6	IGNITION-DISTRIBUTOR PLUG AND SOCKET Visual inspection: Check plug and socket for oxidation.	_____	_____
7	MAGNETIC PULSE GENERATOR, VOLTAGE SUPPLY Ignition-distributor and spark-advance-mechanism plug connected. Push back rubber sleeve of ignition-distributor plug. Voltage, ignition-distributor plug. Ignition ON.	4 2 (+) (-)	equal to/greater than 10 V
8	MAGNETIC-PULSE-GENERATOR FUNCTION Oscilloscope "Special" to ignition-distributor plug and vehicle ground. Actuate starting motor.	12 B- (+) (-)	Rectangular pulse (top picture)
9	SPARK-ADVANCE-MECHANISM FUNCTION Trigger-box plug connected. Push back rubber sleeve. Oscilloscope "Special" to trigger-box plug. Actuate starting motor.	5 B- 6 B- (+) (-)	Rectangular pulse (top picture)
10	IGNITION-DISTRIBUTOR AS-INSTALLED SETTING Set cylinder 1 to TDC in compression stroke. Distributor rotor points to mark on distributor housing. See bottom picture.		



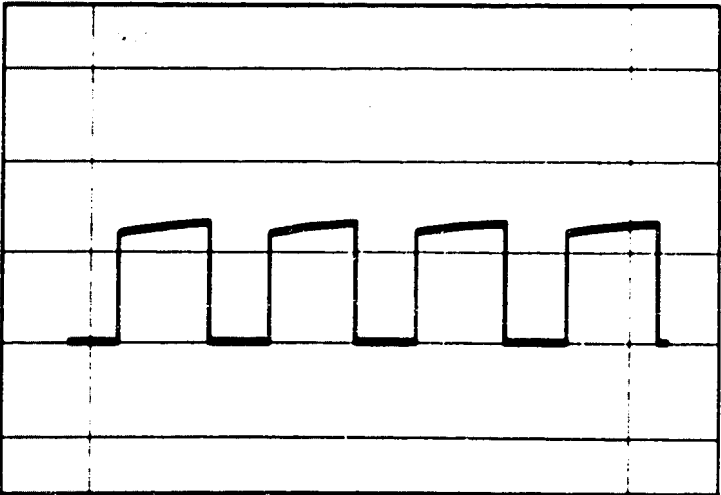
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RAPID DIAGNOSIS CHART (CONTINUED)

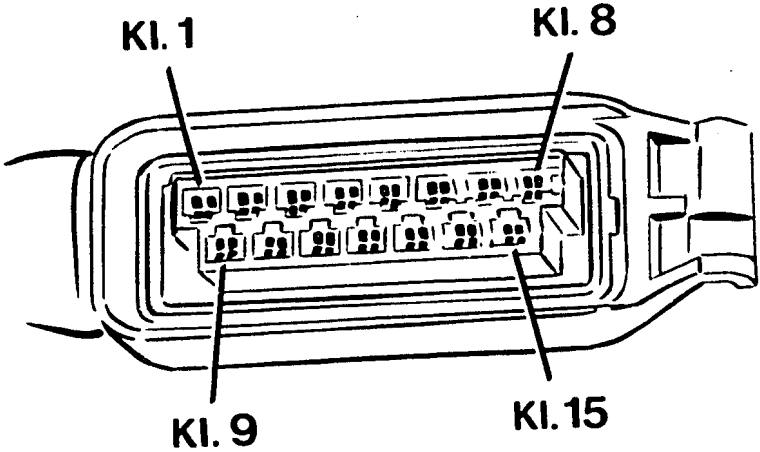
Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
11	PRIMARY SIGNAL Oscilloscope/engine-speed tester to ignition coil. Actuate starting motor.	15 1 (+) (-)	Primary voltage/ engine-speed indica- tion (magnitude irrelevant)
12	CONTACT RESISTANCES (primary side) Detach negative and positive lead from battery. Detach trigger-box plug. Ignition ON. Resistance between battery terminal and trigger-box plug. Resistance between battery terminal and ignition coil. Resistance between trigger-box plug and ignition coil	B+ 4 B- 2 B+ 15 1 1	max. 0.3 Ω max. 0.3 Ω
13	ENGINE-SPEED SIGNAL (JETRONIC) Ignition OFF. Detach Jetronic control-unit plug. Trigger-box and spark-advance-mechanism plug attached. Oscilloscope "Special" to Jetronic control- unit plug. Actuate starting motor.	1 B- (+) (-)	Rectangular pulse (top picture)



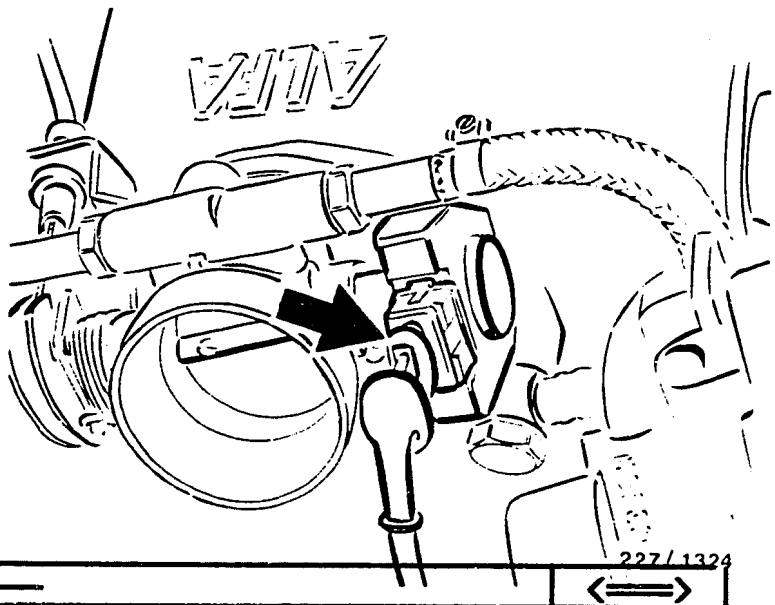
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RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Termi- nals	Set values
14	TEMPERATURE SWITCH Spark-advance-mechanism plug detached. See top picture. Resistance, spark-advance-mechanism plug. Coolant temperature less than 35° C Coolant temperature greater than 40° C	7 B-	infinity Ω 0 Ω
15	THROTTLE-VALVE SWITCH (IDLE CONTACT) Spark-advance-mechanism plug detached. See top picture. Resistance, spark-advance-mechanism plug. Throttle valve in idle setting. Open throttle valve approx. 2°.	6 B-	0 Ω infinity Ω
16	THROTTLE-VALVE SWITCH (FULL-LOAD CONTACT) Spark-advance-mechanism plug detached. See top picture. Resistance, spark-advance-mechanism plug. Completely open throttle valve. Close throttle valve.	14 B-	0 Ω infinity Ω
17	BASIC IGNITION SETTING Detach plug from throttle-valve switch. See bottom picture. (Arrow) Attach shorting device KDZS 0003 to detached plug. Detach vacuum hose at ignition distributor. Allow warm engine to idle. Determine ignition angle, correct in the event of deviation.		800...1000 min -1 8 ± 1° BTDC

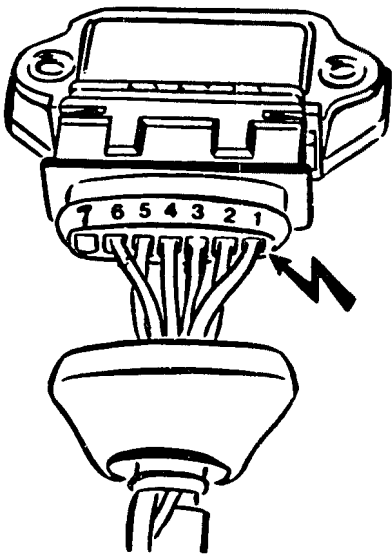


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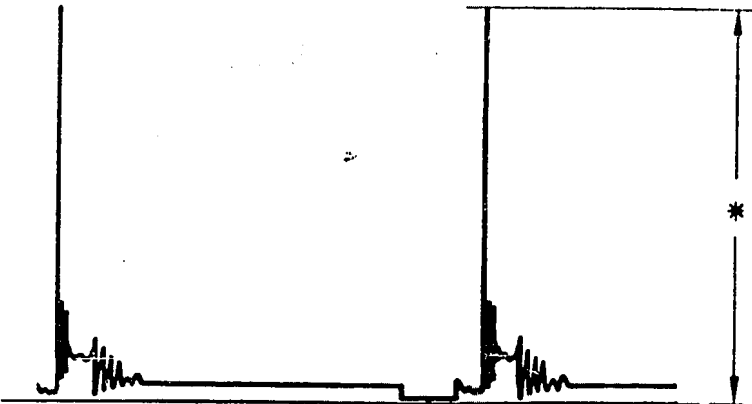


RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
18	VOLTAGE, TRIGGER BOX Push back rubber sleeve at trigger-box plug. Voltage at trigger box. See top picture. Engine idling.	4 2 (+) (-)	12...14 V, max. 1 V below U _B
19	VOLTAGE, IGNITION COIL Voltage, ignition coil and battery. Engine idling.	15 B- (+) (-)	equal to/greater than 10 V
20	PRIMARY VOLTAGE Oscilloscope with pulse-shaping circuit to ignition coil. Engine idling.	15 1 (+) (-)	*290...370 V (bottom picture)



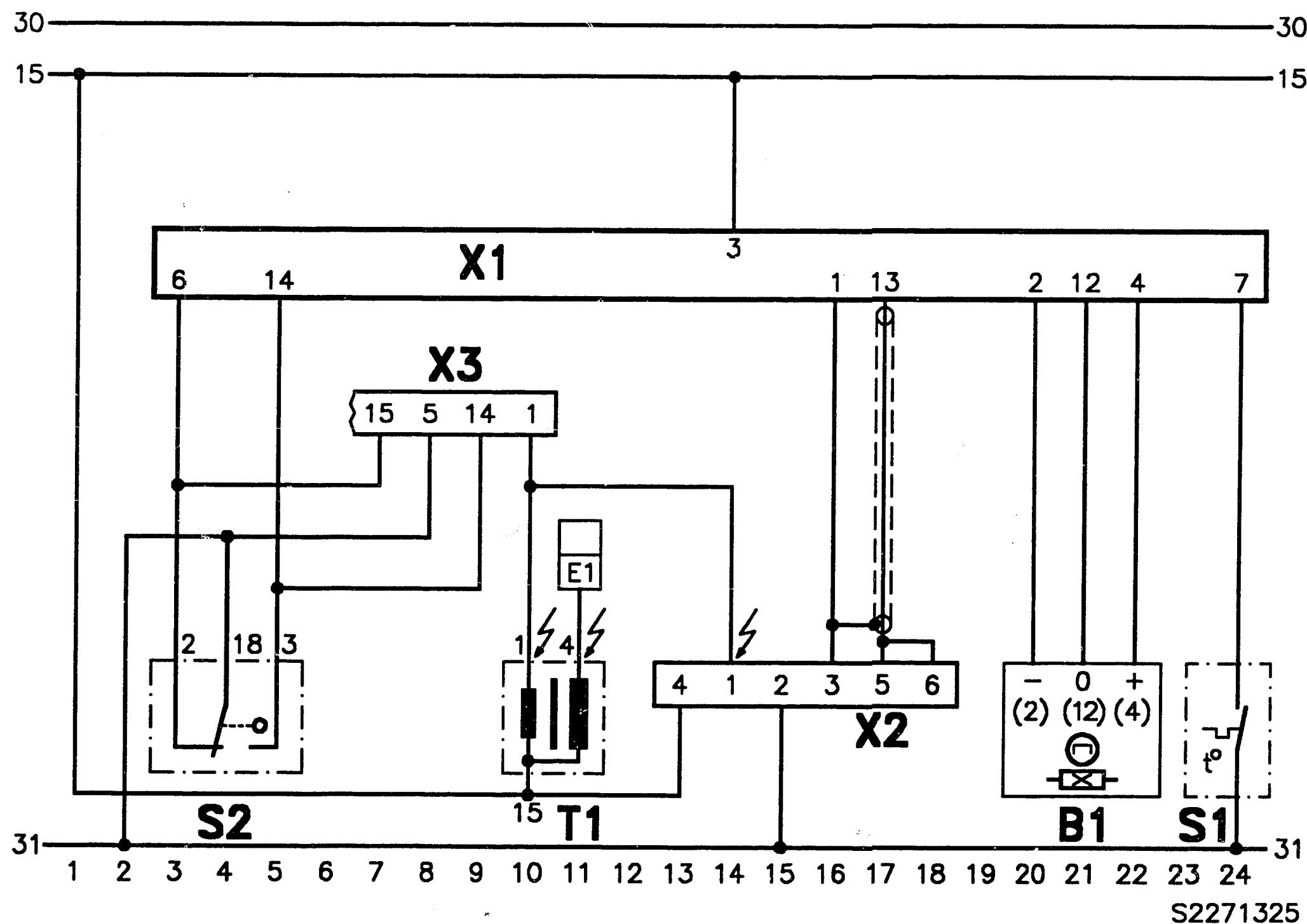
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TEST SPECIFICATIONS

Ignition coil, primary	0,7... 1,2 Ω
secondary	6,9...11,9 k Ω
Voltage, spark-advance mechanism with ignition ON	Battery voltage
Voltage, trigger box with ignition ON	Battery voltage
Voltage, primary circuit with ignition ON	Battery voltage
Voltage supply, magnetic pulse generator with ignition ON	Equal to/greater than 10 V
Magnetic-pulse-generator function at cranking speed	Rectangular pulse
Primary signal at cranking speed	Primary voltage/ engine-speed indication
Basic ignition setting at	8 \pm 1° BTDC 800...1000 min ⁻¹
Voltage supply, spark-advance mechanism with engine idling	12...14 V max. 1 V below U _B
Voltage, trigger box with engine idling	12...14 V max. 1 V below U _B
Voltage, ignition coil with engine idling	Equal to/greater than 10 V
Primary voltage with engine idling	290...370 V
Refer to Autodata test specifications as regards settings for ignition, idle speed, emissions, valve clearance etc.	

For production reasons:
continued on the following
coordinate.



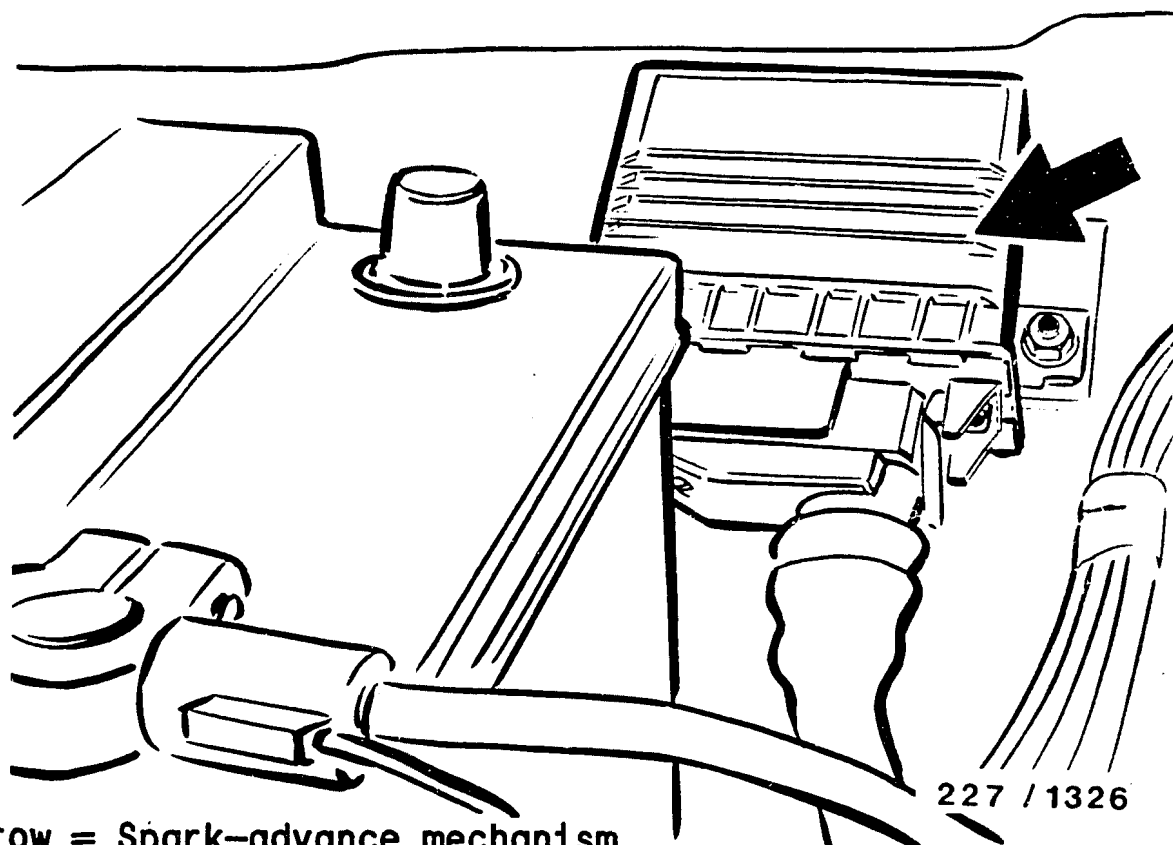
ELECTRICAL TERMINAL DIAGRAM

High-tension arrows = hazardous voltages 400 V - 25 kV

B1 = Magnetic pulse generator
E1 = to ignition distributor
S1 = Temperature switch

S2 = Throttle-valve switch
T1 = Ignition coil
X1 = Spark-advance-mechanism plug

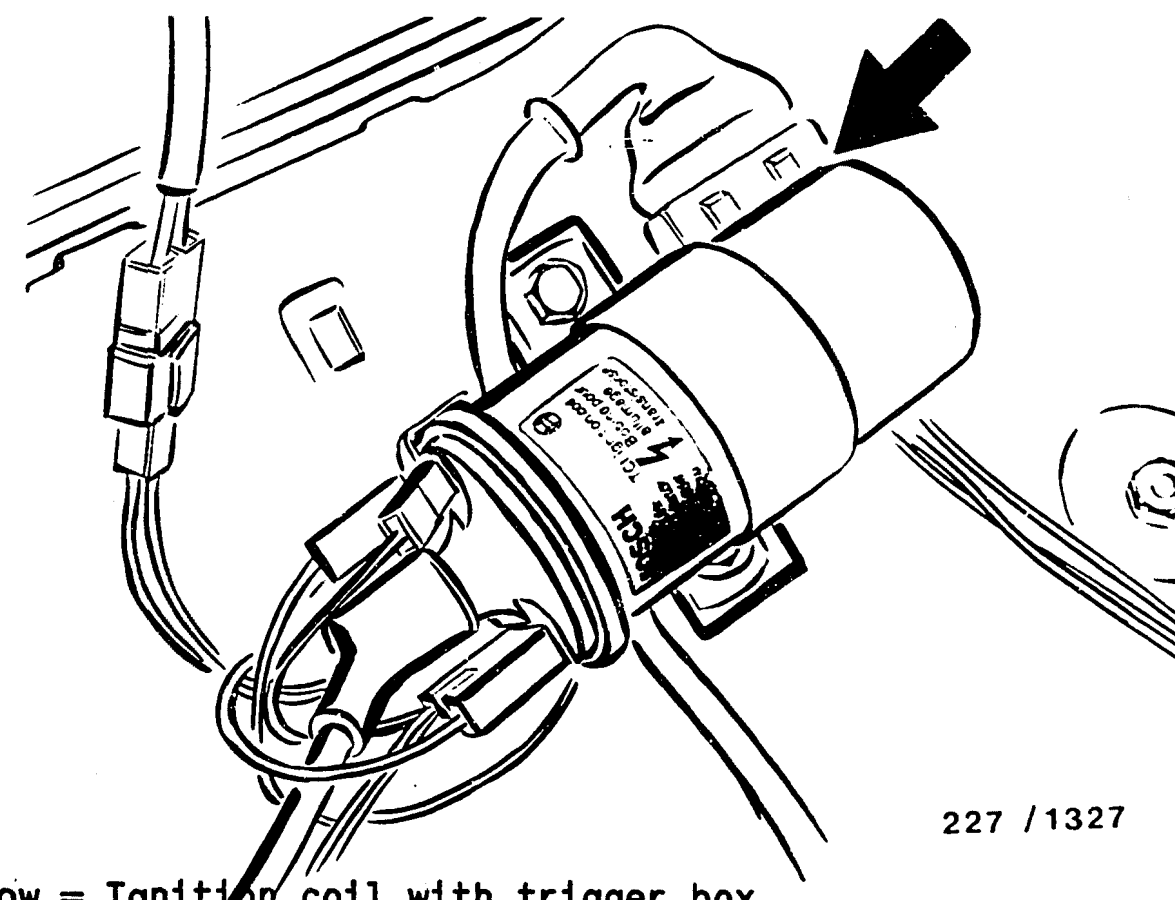
X2 = Trigger-box plug
X3 = Jetronic control-unit plug



Arrow = Spark-advance mechanism

INSTALLATION POSITION OF COMPONENTS

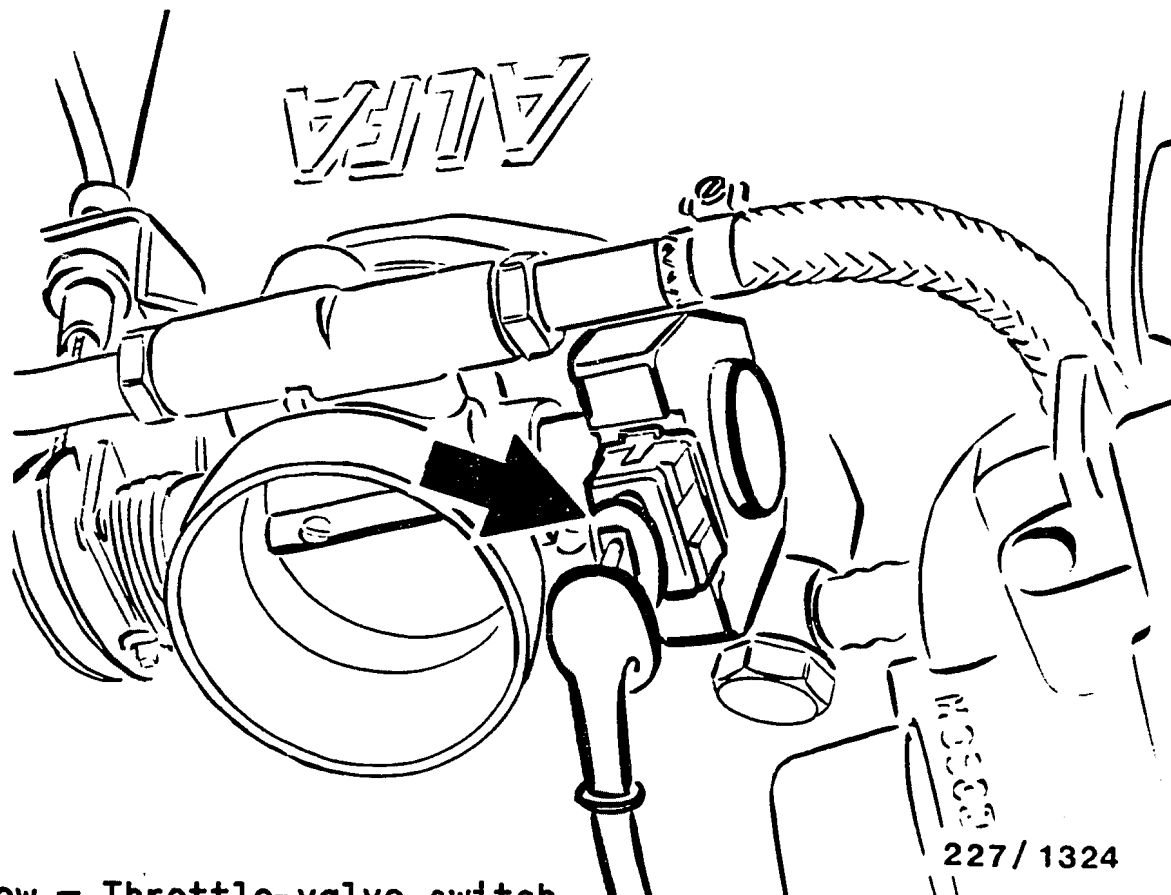
The spark-advance mechanism is located behind the battery at the engine bulkhead.



Arrow = Ignition coil with trigger box

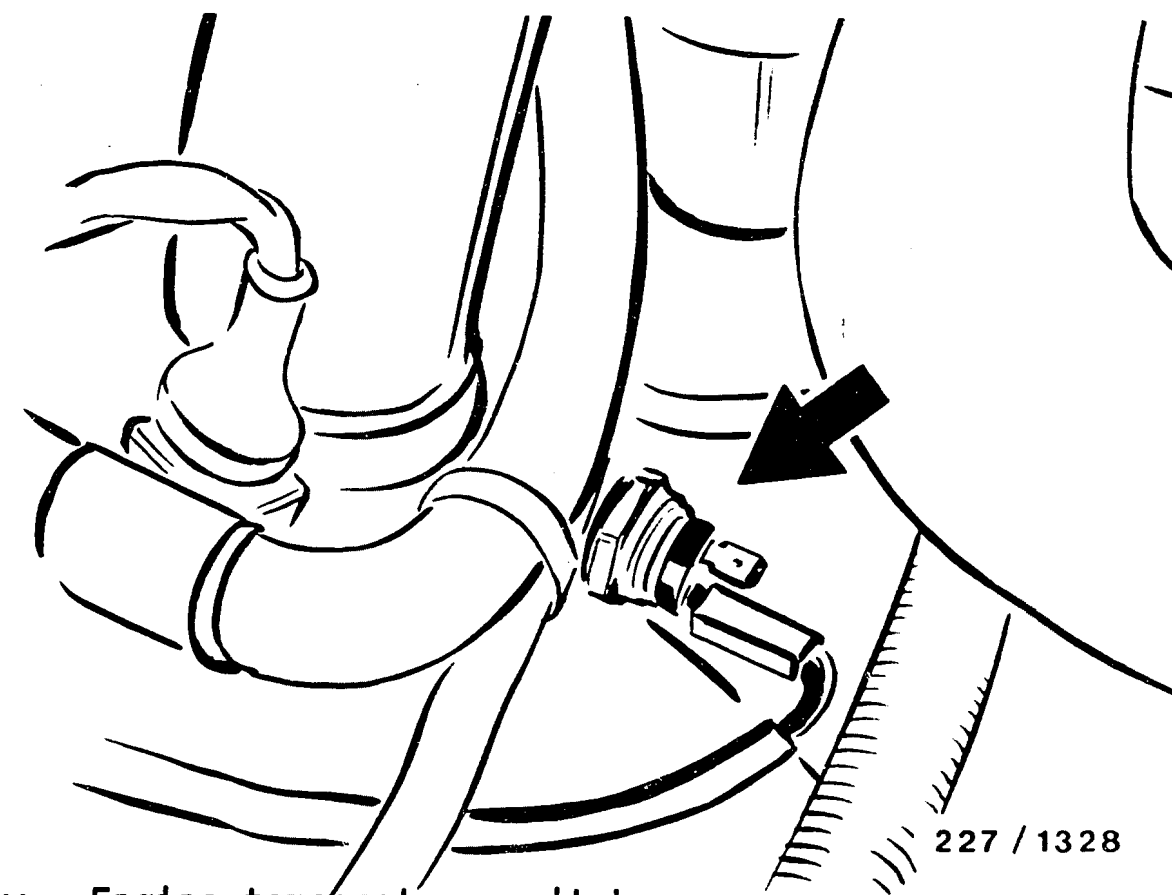
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Ignition coil and trigger box are located on a heat sink at the left-hand inner fender beneath the coolant expansion tank.



Arrow = Throttle-valve switch

INSTALLATION POSITION OF COMPONENTS (CONTINUED)



Arrow = Engine temperature switch

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The engine temperature switch is located at engine cylinder 1 (front right in direction of travel).

Trouble-shooting instructions : ALF-5014
BOSCH system : Motronic ML 4.1
Make of vehicle : ALFA ROMEO
Basic microcard : KFZ-00..

TABLE OF CONTENTS

Section	Coordinates
Special features	02
Structure, usage, safety and precautionary measures	07
Trouble-shooting chart	08
Self-diagnosis test table	09
Test specifications	17
Electrical terminal diagram	21
Installation position of components, notes on removal and installation	25

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

1. ALFA ROMEO 164 Twin Spark (with/without catalytic converter) as of 09.87
2. ALFA ROMEO 75 Twin Spark (without catalytic converter) as of 09.87
3. Alfa ROMEO 75 Twin Spark S (with catalytic converter) as of 01.88

- * Motronic ML 4.1 with self-diagnosis.
Note: The self-diagnosis contains actuator diagnosis (see basic instructions).
- * The fault memory can be read out with the pocket system tester KTS 300 (0 684 400 300) with program module PPG 204 as of status 25.09.89 (only with newer vehicles).
Note:
Further diagnosis possibilities (actuator diagnosis etc.), which would be possible with newer program module statuses, are not evaluated with these vehicles. Pay attention to operating instructions for KTS 300. KTS 300 is connected by way of universal adapter lead of tester to diagnosis connection in vehicle (see next page).
- * As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (see basic instructions).
- * The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault code numbers indicated by the KTS 300.
The "Fault indication" column sometimes includes two types of fault optionally indicated by the tester, e.g.:
Open circuit/short to ground (= 1st type of fault)
Short to positive (= 2nd type of fault)

SPECIAL FEATURES (continued)

How to use self-diagnosis

The latest Alfa models with Motronic feature a connection for tester diagnosis (3-pole connector at Motronic wiring harness, in vicinity of control unit). Refer to top picture. The connection (4-pole) for the evaluation unit KDAW 9980 (flashing code) is now likewise located in the passenger compartment in the vicinity of the control unit and not in the engine compartment (refer to basic microcard).

1. TESTER DIAGNOSIS

Connect pocket system tester KTS 300 by way of universal adapter lead (4 banana plugs) as follows:

Lead with yellow coding to term. 1 in 3-pole plug.

Lead with green coding to term. 3 in 3-pole plug.

Black lead to term. 1 in 4-pole plug (ground).

Red lead to term. 2 in 4-pole plug (switched positive).

See pictures.

2. FLASHING CODE DIAGNOSIS

Connect evaluation unit KDAW 9980 as follows:

Button of evaluation unit (sockets 3 and 4) between term. 1 (ground) and term. 4 (stimulation input) in 4-pole plug.

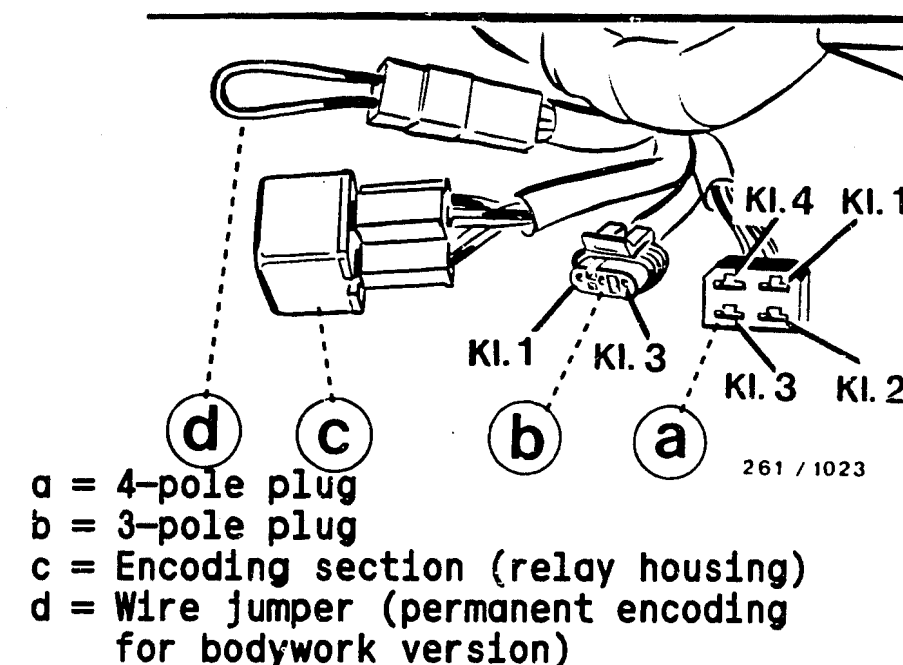
Connect socket 2 of evaluation unit to term. 3 (lamp output stage) and socket 1 (red) to term. 2 (switched positive) or battery positive. Refer to top picture.

Note:

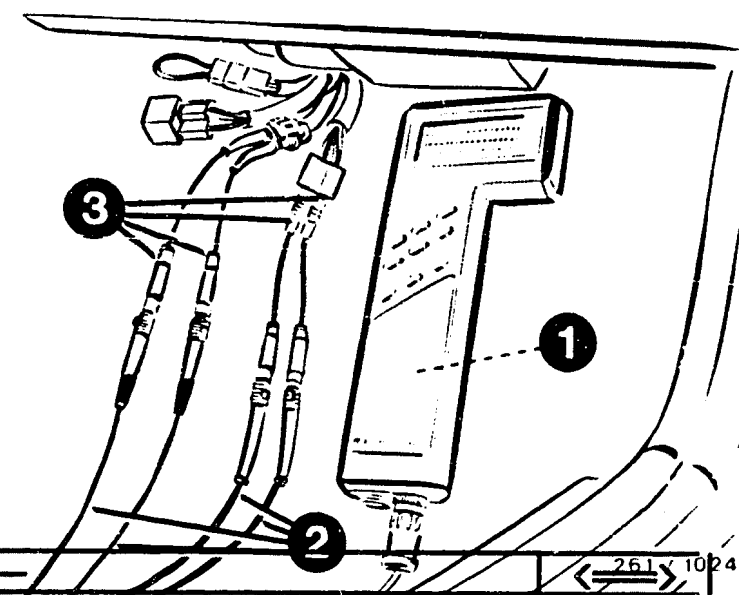
If fault lamp installed in vehicle (currently only US version), do not connect sockets 1 and 2 of evaluation unit and follow flashing code output by way of built-in fault lamp.

N o t e :

For connection of tester or evaluation unit, make use of suitable adapter cables from set of test cables (No. 1 687 011 208).



- 1 = Pocket system tester KTS 300
- 2 = Universal adapter lead for KTS 300
- 3 = Adapter leads from set of test cables



SPECIAL FEATURES (CONTINUED)

- * All models with 2.0 l / 4-cylinder engine with twin spark (2 spark plugs per cylinder; 2 ignition coils with flanged-on ignition trigger boxes TI-61 actuated via Motronic term.1 and term. 19; 2 ignition distributors).
- * Joint sensor for engine speed and reference mark.
- * Idle-speed regulation with single-winding rotary actuator (EWD).
- * Fault lamp ("CARB lamp") in instrument panel on US models.
- * Adaptive lambda control with catalytic converter version.
- * Tank-ventilation switching valve on catalytic-converter version (not from Bosch).
- * Variant encoding for octane-number adaptation (term. 10) and "Country variant" (with/without lambda control; term. 27). Refer to basic instructions.
- * Air-flow sensor with CO potentiometer (CO setting electrical by way of potentiometer) on models without catalytic converter.

Check ignition output stages.

Perform test if no primary signal is applied to one of the ignition coils (term. 1).

1. Measure battery voltage at each ignition coil (term. 1) with ignition switched on.
Continue test if O.K.

2. Check actuation signal.

- * Control-unit plug and connector attached to ignition output stages.

- * Push back rubber sleeves of both connectors of ignition output stages.

- * Connect special input of oscilloscope to term. 4 of respective ignition output stage.

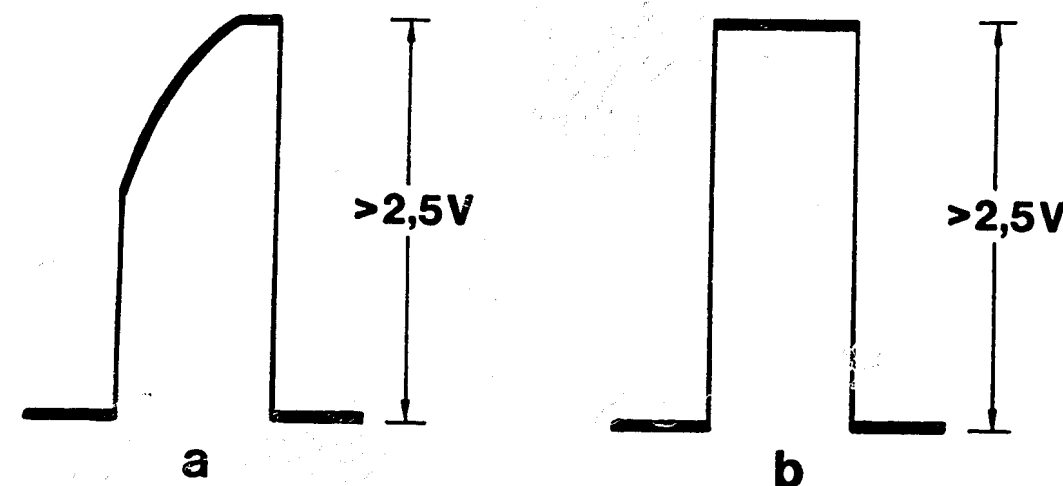
- * Start engine and observe signal.

Set value: Amplitude of rectangular signal (picture a, coordinate 06) must be greater than 2.5 V at each ignition output stage.

If set value is not attained, detach plug from ignition output stage. Connect voltmeter to term. 3 (+) and term. 2 (-).

Switch on ignition.

Set value: battery voltage.



a = Actuation signal with connected ignition output stage

b = Actuation signal with resistance to ground.

SPECIAL FEATURES (CONTINUED)

Check ignition output stages (continuation)

If set value is not attained, check leads to relief relay term. 87 and to ground. Continue test if leads O.K.

- * At detached plug, connect resistor with 220 Ω to term. 4 with respect to ground.

Start engine and observe signal.

Set value: Amplitude of rectangular signal (picture b) must be greater than 2.5 V.

If set value is not attained, check lead to control unit term. 1 or term. 19.

If lead O.K., control unit defective —> replace.

If set value attained, ignition output stage defective —> replace.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

- * Avoid injection of fuel and high-voltage flashovers when testing the compression.
Therefore, disconnect Motronic relay.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

											Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference-mark sensor
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*				*							Ignition trigger box
*	*	*	*		*	*		*	*		Ignition angle
*		*			*	*					Fuel pressure
		*			*						Throttle valve
*		*				*	*				Solenoid-operated injection valves
*	*	*	*	*	*	*					Air-flow sensor
*	*	*	*								Air intake system
	*	*	*								Idle actuator
					*						Fuel delivery
					*						Interference
		*	*	*							Interference-suppression resistors
		*	*								Idle contact
					*						Full-load contact
		*									Idle speed, CO
		*	*	*	*						Camshaft switching
		*					*				Tank ventilation
		*									Overrun cutoff
*	*	*	*	*	*	*		*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Data exchange not possible	—	—	Prerequisite for fault output: leads between control unit and diagnosis socket/fault lamp (flashing code) as well as voltage supply for control unit O.K. Note: Fault lamp is currently only installed in US models in instrument panel (CARB lamp).	04 12 17	—
Control unit Digital sec.(comput) defective	01	1251	Control unit defective.	—	—
Relay Fuel pump Op.circ/Ground short Short to B+	03	1243	Fault 1: Open-circuit (Op.circ) or short to ground (ground short). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive (short to B+). Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition switched on: Resistance of relay coil (term. 85/86): Check lead to control unit (term. 20).	20	10...15 V approx. 50...150 Ω
Idle actuator ZWD Winding 1/EWD Op.circ/Ground short Short to B+	04	1222	Check leads and plug connection of actuator for open-circuit (op.circ), short-circuit to ground (ground short) and short-circuit to positive (short to B+). Winding resistance at +15...+30°C:	33	approx. 8 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	07	1221	Signal too low: check lead to air-flow sensor term. 2 (signal) and term. 3 (approx. +5 V) for open-circuit and short-circuit to ground. Signal too high: check lead to air-flow sensor term. 2 for short-circuit to positive (+5V or +12V) and ground lead (term. 4) for open-circuit. Check resistances at air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Measure wiper voltage at term. 2 with plug connected and ignition switched on (sensor flap in off-position): Slowly deflect sensor flap as far as full load:	07(S)* 09(+) 06(-)	 8...2500 Ω 300... 550 Ω 0,1...0,3 V greater than 4,2 V
Lambda control outside min. range outside max. range	10	1223	Note: Fault code 10 applies only for cat. models. Check CO content (ahead of catalytic converter). Check intake system and exhaust system for leaks. Incorrect fuel pressure. Sensor defective. Injection valve(s) clogged or not functioning. Important: Check Motronic ground connections at engine and/or bodywork (including ground strap between engine and bodywork) for contact resistances and open-circuits. Voltage supply of control unit must also be in perfect working order.	—	—
Fault lamp Op.circ/Ground short Short to B+	15	1265	Note: Fault lamp is currently only installed in US models in instrument panel (CARB lamp). Check lead to fault lamp for short-circuit to ground (ground short) and short-circuit to positive (short to B+). Open-circuit (op.circ) is not detected!	17	—

*) S = signal

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Relay Camshaft switchover Op.circ/Ground short Short to B+	23	1245	Fault: Short-circuit to ground (ground short), to battery voltage or open-circuit (op.circ) Check leads for open-circuits and short-circuits. Resistance of relay coil:	31	approx. 50...150 Ω
Lambda sensor Open circuit Short to ground Short to B+	28	1224	Note: Fault code 28 applies only to cat. models. Check lead for open-circuit, short to ground and short- circuit to positive (B+). Watch out for worn insulation! Sensor heating defective. Sensor clogged.	24	—
Valve Tank ventilation Op.circ/Ground short Short to B+	34	1244	Note: Only CAT models have tank ventilation valve. Check lead for contact with ground or positive. Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit defective. Check lead for open-circuit (op.circ).	34	approx. 30 Ω
Battery voltage too low too high	37	1211	Supply voltage for control unit too low: Check voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Check alternator regulator.	18(+)* 35(+) 05(-)	greater than 10 V (with engine running) less than 16 V (with engine running)
CO potentiometer Signal too low Signal too high	43	1215	Note: CO potentiometer is only active on models without lambda closed-loop control. Signal too low: Check lead to air-flow sensor term. 1 for open-circuit and short-circuit to ground. Signal too high: Check same lead for short-circuit to voltage-carrying lead. Check potentiometer (and CO). To do so, measure voltage at air-flow sensor term. 1 with ignition switched on:	30	 0.8...4.5 V

*) = Permanent positive for fault memory and adaption.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flash- ing code	Test instructions/Test conditions	Termi- nals	Set values
Air-temp. sensor Op. circ./sh. to B+ Short to ground	44	1225	Check temperature sensor and lead for open-circuit (op. circ.), short to ground and short-circuit to positive (short to B+). Temperature-sensor resistance at +15...+30°C:	22	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1214	Check temperature sensor and lead for open-circuit (op. circ.), short to ground and short-circuit to positive (short to B+). Temperature-sensor resistance at +15...+30°C: at approx. +80°C:	13	1450...3300 Ω 280... 360 Ω
Idle swi'ch Short to ground	52	1212	Fault: Idle contact (in throttle-valve switch) permanently closed or short to ground in lead. Idle contact closed in off-position: Actuate throttle valve somewhat:	02	approx. 0 Ω infinity Ω
Full-load switch Short to ground	53	1213	Fault: Full-load contact (in throttle-valve switch) permanently closed or short to ground in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	03	approx. 0 Ω infinity Ω
No fault stored	—	4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	—	—
—	—	0000 or 1000	End of output (flashing code only)	—	—

TEST SPECIFICATIONS

Pressure regulator	
* Fuel pressure	2,8...3,2 bar
Electric fuel pump	
* Delivery (measured in return line)	min. 750 cm ³ /30s
Supply voltage (under load):	min. 12 V
Temperature sensor (intake air)	
* Internal resistance measured at air-flow sensor between term. 5 and term. 4 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine), plug color, blue.	
* Internal resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
engine at operating temperature (approx. + 80° C):	280... 360 Ω
Solenoid-operated injection valve	
* Internal resistance at ambient temperature (+ 15° C...+ 30° C):	15...17,5 Ω
Air-flow sensor	
* Internal resistance between:	
term. 2 and term. 4 :	8...2500 Ω (1)
term. 3 and term. 4 :	300... 550 Ω
term. 1 and term. 4 (CO potentiometer):	
Minimum	0...30 Ω
Maximum: the actual value measured between term. 3 and term.4 may be up to 30 Ω less.	
(1) Slowly deflect air-flow sensor flap as far as it will go. Fluctuating increase in resistance; slight decrease towards end.	

TEST SPECIFICATIONS (continued)

Engine-speed sensor and reference-mark sensor	
* Internal resistance at ambient temperature (+15°C...+30°C):	400...800 Ω
* Air gap:	0,8 ± 0,5 mm
Throttle-valve switch	
* Resistance of idle contact (term. 2 and term. 18):	approx. 0 Ω
* Resistance of full-load contact (term. 3 and term. 18):	approx. 0 Ω
Idle actuator	
* Internal resistance at +15°...+30°C :	approx. 8 Ω
Lambda sensor	
* Resistance of heater winding:	1...15 Ω
Tank-ventilation switching valve (not from Bosch)	
* Internal resistance:	approx. 30 Ω
Ignition coil	
* Primary resistance:	approx. 0,6...1,0 Ω
* Secondary resistance:	6400...11100 Ω

TEST SPECIFICATIONS (continued)

Idle test
(engine at operating temperature,
switch off loads).

* Idle speed:
without catalytic converter: $800 \pm 50 \text{ min}^{-1}$
with catalytic converter: $800 \pm 50 \text{ min}^{-1}$ +)

* Spark-advance angle: $10 \pm 5^\circ \text{CS}$ +)

Automatic transmission set to N or P

* CO content:

without catalytic converter: $0,5 \dots 1,5 \text{ vol.}\% \text{CO}$ +)

Perform mixture adjustment
at CO potentiometer in air-
flow sensor:
Counter-clockwise = leaner mixture,
clockwise = mixture enrichment.

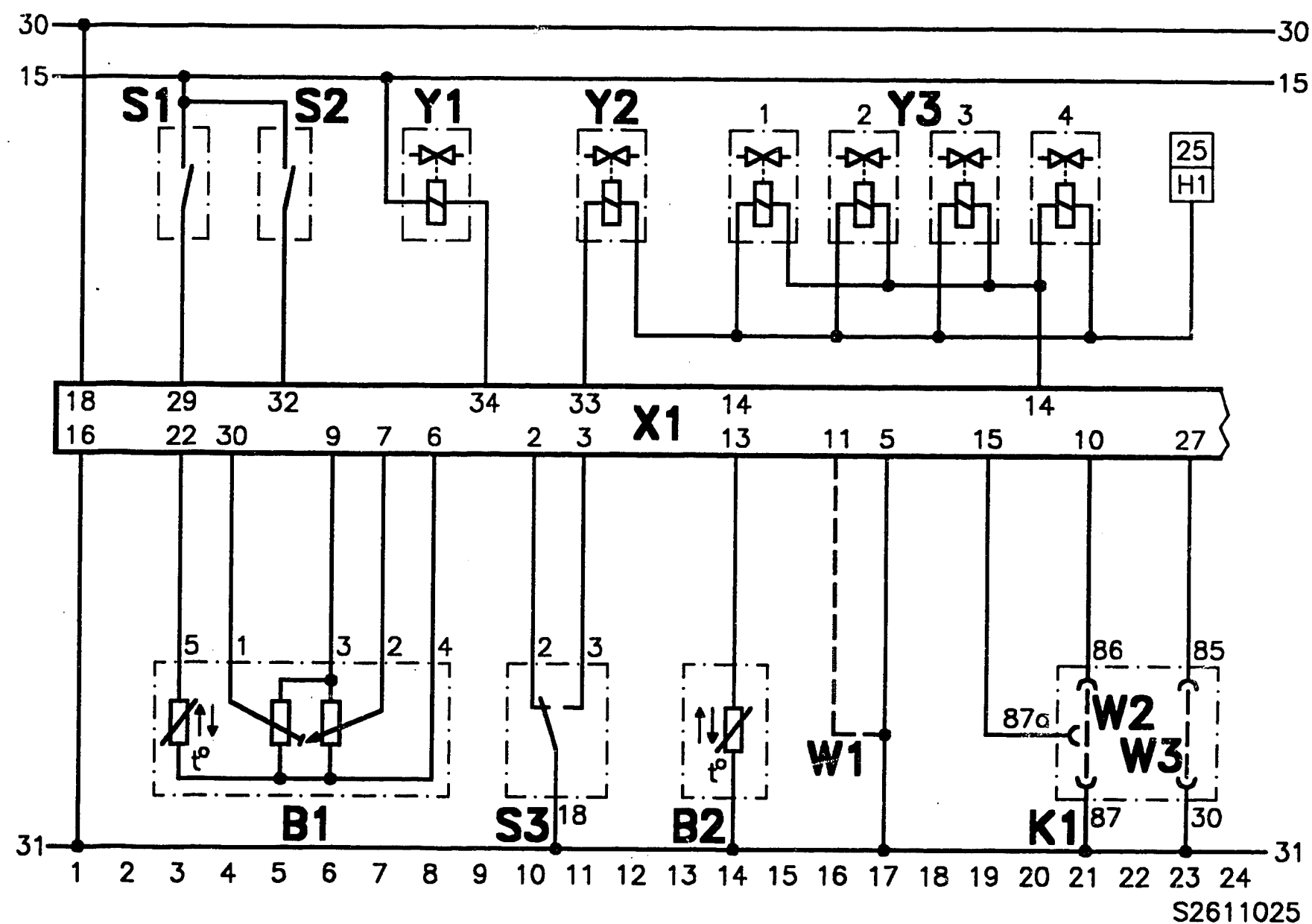
The potentiometer can be used
to adjust the injection time by
a maximum of 0.6 ms.

* Vehicles with catalytic converter:
ahead of catalytic converter $0,7 \pm 0,3 \text{ vol.}\% \text{CO}$
downstream of catalytic converter approx. 0 vol.% CO
(max. 0.2 %)

For production reasons:
continued on the following
coordinate.

+) Important! Variant coding may lead
to a deviation in the
stated basic values.
Pay attention to basic microcard!

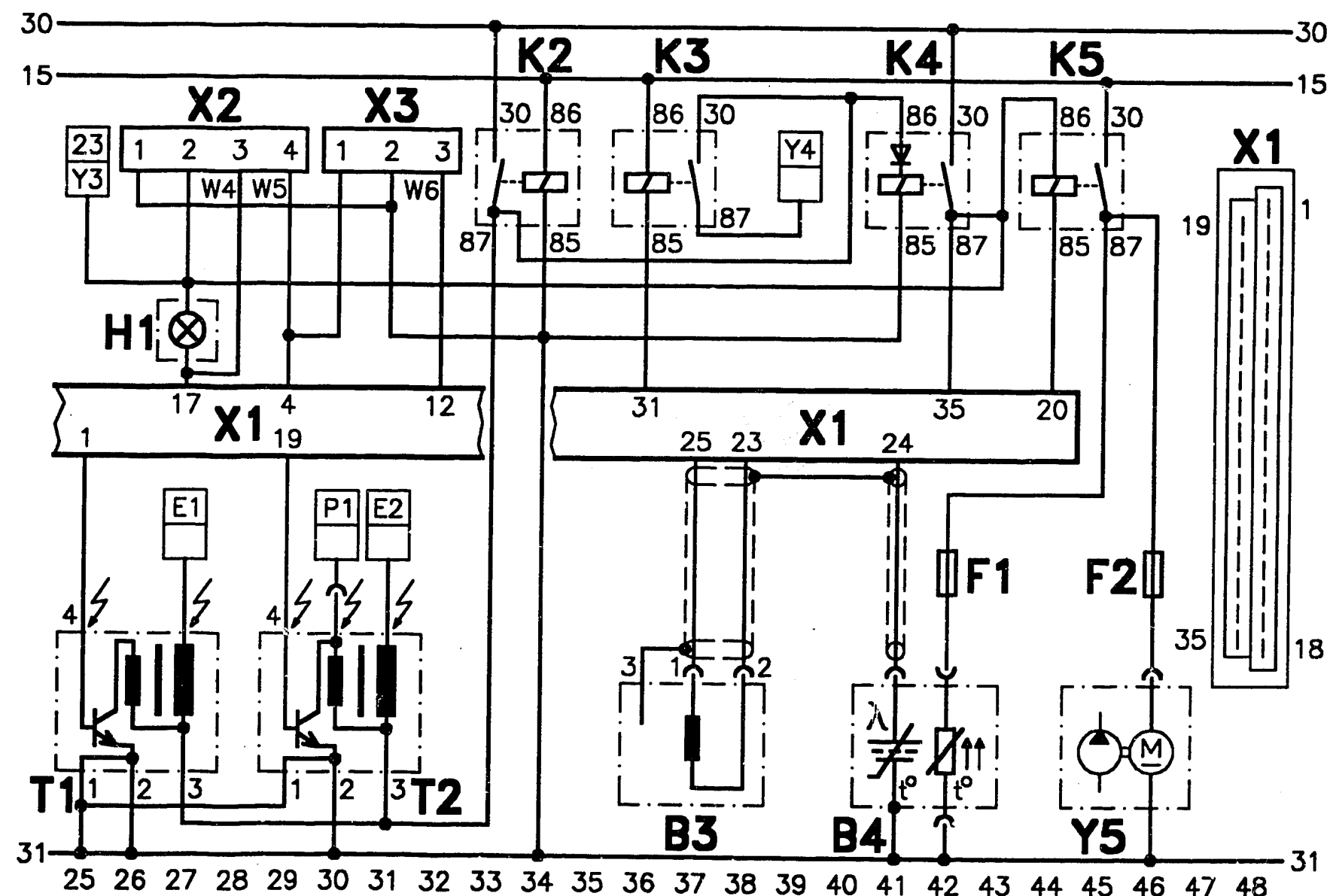
Please refer to equipment and Autodata
microcard for valve-clearance settings and
other engine-related data.



ELECTRICAL TERMINAL DIAGRAM

B1= Air-flow sensor with
CO potentiometer
B2= Temperature sensor (engine)
H1= Fault lamp (CARB; USA only)
K1= Encoding section (relay housing)
S1= Switch, A/C readiness
S2= Switch, A/C compressor
S3= Throttle-valve switch

W1= Permanent encoding for bodywork variant
(Alfa 75/Alfa 164)
W2= Encoding link for fuel variant
W3= Encoding link for cat./no cat.
X1= Control-unit plug (35-pole)
Y1= Tank-ventilation switching valve
(TES; not from Bosch)
Y2= Idle actuator (EWD)
Y3= Solenoid-operated injection valves



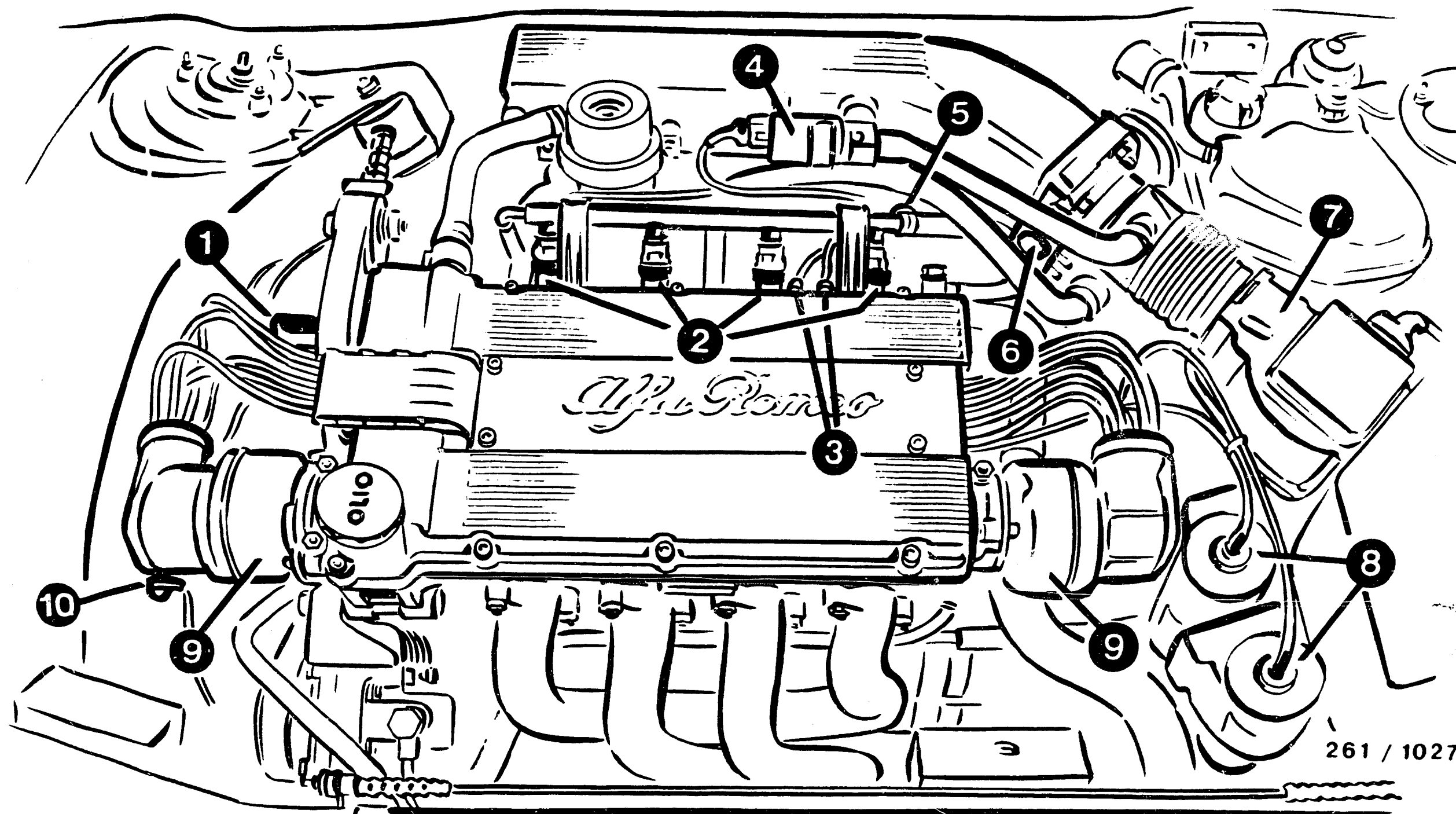
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ELECTRICAL TERMINAL DIAGRAM (continued)

B3= Engine-speed/reference-mark sensor
 B4= Heated lambda sensor
 E1= H.T. distributor 1
 E2= H.T. distributor 2
 F1= Sensor-heater fuse
 F2= Fuel-pump fuse
 H1= Fault lamp (CARB; USA only)
 K2= Relief relay
 K3= Relay for camshaft switching

K4= Main relay
 K5= Pump relay
 P1= Rev counter
 S1= Switch, A/C readiness
 S2= Switch, A/C compressor
 S3= Throttle-valve switch
 T1= Ignition coil 1
 T2= Ignition coil 2
 W4= Fault-lamp output stage
 W5= Stimulation line

W6= Serial interface
 X1= Control-unit plug (35-pole)
 X2= 4-pole diagnosis connection (flashing code)
 X3= 3-pole diagnosis connection (tester)
 Y4= Solenoid valve for camshaft switching
 Y5= Electric fuel pump



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INSTALLATION POSITION OF COMPONENTS (Alfa 164 Twin Spark)

- 1 = Solenoid valve for camshaft switching
- 2 = Solenoid-operated injection valves
- 3 = Motronic ground terminals
- 4 = Idle actuator (EWD)
- 5 = Measurement point for fuel pressure

- 6 = Throttle-valve switch
- 7 = Air-flow sensor
- 8 = Ignition coils with ignition output stages
- 9 = Ignition distributor (two)
- 10 = Plug connection, engine-speed/reference-mark sensor

INSTALLATION POSITION OF COMPONENTS (continued)

The installation locations always refer to the direction of travel.

* Control unit:

Alfa 164 Twin Spark: above ABS control unit (top picture, Item 1)

Alfa 75 Twin Spark: behind cover plate beneath floor mat on passenger's side (center picture, item 1).

* Encoding connection:

5-pole relay frame at Motronic wiring harness in vicinity of control unit. Item 2 in top picture (Alfa 164) and center (Alfa 75).

* 3 and 4-pole diagnosis connections:

at Motronic wiring harness in vicinity of control unit (Alfa 75 see center picture, item 3)

* Lambda-sensor plug connection:

Alfa 164 Twin Spark: approx. beneath coolant expansion tank (bottom picture, left: 1 = Signal line, 2 = Sensor heater, 3 = Air-flow sensor).

Alfa 75 Twin Spark S: at rear engine bulkhead (bottom picture, right: 1 = Signal line, 2 = Sensor heater).

* Fuse box:

beneath instrument panel, left.

* Temperature sensor (intake air):

in air-flow sensor.

* Temperature sensor (engine):

at intake side of engine block (blue plug).

* Throttle-valve switch (Alfa 75 Twin Spark):

at bottom of throttle-valve assembly.

* Pressure regulator:

at fuel distributor

* Active-carbon container (cat. only):

beneath vehicle, ahead of front wheel house (Alfa 164 Twin Spark, left/Alfa 75 Twin Spark S, right).

* Tank-ventilation switching valve (cat. only):

Alfa 164 Twin Spark: in vicinity of active-carbon container.

Alfa 75 Twin Spark S: next to radiator, right.

